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AQUACULTURE EXTENSION SERVICES REVIEW:

THE PHILIPPINES

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AQUACULTURE EXTENSION SERVICES REVIEW:

THE PHILIPPINES

by

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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PREPARATION OF THIS DOCUMENT

In 1982, FAO Fisheries Circular N. 747 entitled "Aquaculture extension services review" was published. This publication gave a brief outline of the status of aquaculture extension services in 32 countries. In those early days of aquaculture development, aquaculture extension services were in their infancy, and in many countries they were not in existence.

The last decade, however, has seen dramatic development of aquaculture, especially in Asia. It is believed that the extension services played an important role in this rapid development by effectively transferring culture technologies to the producers. It is therefore important that the present status of the aquaculture extension services are reviewed, especially in the countries where aquaculture development is believed to have made some impacts in the socio-economic life of the rural people.

Bearing this in mind, this review has been prepared within the framework of the Regular programme activities of the FAO Inland Water Resources and Aquaculture Service of the Fishery Resources Division. The original text, prepared by Dr. Herminio R. Rabanal in Manila, has been edited by Mr. P.C. Choudhury in Rome.

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ABSTRACT

The Philippines is a major fish producing country in the world, ranking 11 among the world fisheries producers. In aquaculture, the Philippines holds the 5th position in the world. The country is a net exporter of fishery products, exporting US$468 million against an import value of US$96 million. Out of a total fish production of 2.6 million t, 28 % (736,000t) comes from aquaculture (1992).

In Philippines, aquaculture production comes mainly from six production system: brackishwater ponds, freshwater ponds, fish pens (mainly in freshwater), fishcages (mainly in freshwater), molluscs farming and seaweeds farming. The main species groups cultured are milkfish, tilapia, jumbo tiger shrimp, oyster, mussels and seaweeds.

The country has high potential for further growth in aquaculture, especially in mariculture of fish, molluscs and seaweeds. However, many technical, administrative and management problems must be resolved before further growth in the aquaculture industry is possible.

The government gives high priority to the development of fisheries, including aquaculture. Under the national Medium-term Economic Development Plan, a Medium-term Fisheries Development Plan is being implemented. The Department of Agriculture through its Regional offices carry out agricultural development activities including that of fisheries and aquaculture. The various specialized agencies under the Department of Agriculture, especially the Bureau of Fisheries and Aquatic Resources (BFAR), Bureau of Agricultural Research (BAR), Bureau of Agricultural Statistics (BAS) and the Agricultural Training Institute (ATI), cooperate and contribute towards the development of aquaculture.

The aquaculture extension services are provided by the Department of Agriculture through two nationwide programmes: (i) Fisheries Sector Programme (FSP), and (ii) National Fisheries Outreach Programme (NFOP). The former is an inter-agency programme to rehabilitate, conserve and regenerate fisheries/aquaculture resources while at the same time alleviating poverty amongst the marginal fisherman/fishfarmers. The latter programme, NFOP, is responsible for sustainable and equitable management of fisheries and aquaculture and is operated by the local government with full participation and cooperation of NGOs and Local Fishing Communities.

The aquaculture extension policies, plans and programmes are embodied in the Medium Term Fisheries Management and Development Plan (MTFMDP) of 1993-98. The plan envisages aquaculture production increase from 0.74 million in 1993 to 1.0 million t in 1998, at a cost of 5.3.96 billion pesos.

Aquaculture extension services cover brackiswater/freshwater pond culture, rice-fish culture, fish culture in pens and cages, and mariculture of molluscs and seaweeds. The extension methods applied are individual/group methods, demonstrations, training and visits, mass media, field trips/workshops, and training in extension schools and farmers training centres. The review also contains information on technologies, input supplies, subsidies, extension control mechanisms, extension and research linkages, part played by NGOs etc. Within the context of aquaculture extension services in the country, the subjects of aquaculture production, marketing of aquaculture products and the socio-economic benefits derived from aquaculture have been dealt with.

LIST OF ABBREVIATIONS

AADCP	–	ASEAN Aquaculture Development and Coordination Programme
ACPC	–	Agricultural Credit Policy Council
ADB	–	Asian Development Bank
ADSEA	–	Aquaculture Development in Southeast Asia
APTs	–	Agricultural Production Technicians
AQD	–	Aquaculture Department of the Southeast Asian Fisheries Development Center (SEAFDEC/AQD)
ARMM	–	Autonomous Region of Muslim Mindanao
ASEAN	–	Association of Southeast Asian Nations
ATI	–	Agricultural Training Institute
ATs	–	Agricultural Technologists
BAE	–	Bureau of Agricultural Extension (now ATI or Agricultural Training Institute)
BAECON	–	Bureau of Agricultural Economics (now BAS or Bureau of Agricultural Statistics)
BAI	–	Bureau of Animal Industry
BAR	–	Bureau of Agricultural Research
BAS	–	Bureau of Agricultural Statistics
BCD	–	Bureau of Cooperative Development (now CDA or Cooperative Development Authority)
BFAR	–	Bureau of Fisheries and Aquatic Resources
BMC	–	Bay Management Council
BPI	–	Bureau of Plant Industry
BS	–	Bureau of Soils (now BSWM or Bureau of Soil and Water Management)
CAR	–	Cordillera Autonomous Region
CARL	–	Comprehensive Agrarian Reform Law
CBP	–	Central Bank of the Philippines (now BSP or Banko Sentral ng Pilipinas)
CFOs	–	Community Fishery Officers
CGIAR/TAC	–	Consultative Group on International Agriculture Research/Technical Advisory Committee
CLSU	–	Central Luzon State University
CRM	–	Coastal Resource Management
DA	–	Department of Agriculture
DANR	–	Department of Agriculture and Natural Resources (this is now reorganized)
DBP	–	Development Bank of the Philippines
DECS	–	Department of Education, Culture and Sports
DENR	–	Department of Environment and Natural Resources
DILG	–	Department of Interior and Local Government

DTI	–	Department of Trade and Industry
DOST	–	Department of Science and Technology
FAs/FOs	–	Fisheries (Fishermen's, Fishfarmers') Associations/Organizations
FCR	–	Food Conversion Ratio
FIDC	–	Fishery Industry Development Council (abolished and functions transferred to relevant offices)
FLA	–	Fishpond Lease Agreement
FMTs	–	Farm Management Technicians
FRETFAC	–	Fisheries Research and Extension Task Force Advisory Committee (of Fisheries Sector Program)
FSP	–	Fisheries Sector Program
GFSME	–	Guarantee Fund for Small and Medium Enterprises
GIFT	–	Genetic Improvement of Farmed Tilapia
HMTs	–	Home Management Technicians
ICLARM	–	International Center for Living Aquatic Resources Management
LGC	–	Local Government Code
LGUs	–	Local Government Units
MAF	–	Ministry of Agriculture and Food (no longer existing)
MAO	–	Municipal Agricultural Officer
MIS	–	Management Information System
MNR	–	Ministry of Natural Resources (no longer existing)
MSI	–	Marine Science Institute (of the University of the Philippines or UP-MSI)
MTFMDP	–	Medium Term Fisheries Management and Development Plan
NCR	–	National Capital Region
NEP	–	National Extension Project (A World Bank Loan Project)
NFIS	–	National Fisheries Information System
NFOP	–	National Fisheries Outreach Program (of the Fisheries Sector Program)
NGOs	–	Non-Government Organizations
P Ps	–	Philippine Pesos
PAO	–	Provincial Agricultural Officer
PCAMRD	–	Philippine Council for Aquatic and Marine Research and Development
PCARRD	–	Philippine Council for Agriculture, Forestry and Natural Resources Research and Development
PIFT	–	Philippine Institute of Fisheries Technology (absorbed by the University of the Philippines, College of Fisheries)
PIO	–	Program Implementing Officer (for the Fisheries Sector Programs)
PFC	–	Philippine Fisheries Commission (now BFAR)
PFDA	–	Philippine Fisheries Development Authority
PFMUs	–	Provincial Fisheries Management Units
PMO	–	Project Management Office (of the Fisheries Sector Program)

PNG	–	Philippine Natural Grade (referring to carrageenan from *Eucheuma* seaweed)
QUEDANCOR	–	Quedan and Rural Credit Guarantee Corporation
REC	–	Research and Extension Component (of the Fisheries Sector Program)
RFMUs	–	Regional Fisheries Management Units (of the Fisheries Sector Program)
RFTC	–	Regional Fishermen's Training Center
RIFT	–	Regional Institute of Fisheries Technology
RO	–	Regional Office (of the Department of Agriculture)
ROI	–	Return on Investment
RYDOs	–	Rural Youth Development Officers
SAFD	–	Special Assistant for Fisheries Development (of Regional Fisheries Management Units of the Fisheries Sector Program)
SCUs	–	State Colleges and Universities
SEAFDEC	–	Southeast Asian Fisheries Development Center
TLRC	–	Technology and Livelihood Resource Center
TWGs	–	Technical Working Groups
UP	–	University of the Philippines
UPV	–	University of the Philippines in the Visayas

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AQUACULTURE EXTENSION SERVICES REVIEW: THE PHILIPPINES

1. BACKGROUND

The Philippines is an archipelagic country in Southeast Asia, part of the Asia-Pacific Region (Figure 1). Among the countries of the world it is one of the major producers of fish and fishery products, ranking among the highest as shown by the fact that within the recent two decades it has ranked 11th to 14th among world fisheries producers (Table 1). In aquaculture, it is 5th or 6th among world producers (Table 2). It is the highest producer of milkfish, second highest producer of red seaweed and ranks high in the production of tuna, tilapia and shrimps. Its fish supply has attained positive balance and is now a net exporter of fishery products rather than importer contrary to several years back. In 1991, the country exported fishery products valued at US$467.7 million while imports was only US$96.1 million (FAO, 1993).

1.1 Introduction

1.1.1 Physical geography

Located just north of the equator in the western rim of the Pacific Ocean, the Philippines as an archipelago has some 7 100 big and small islands; it has a long coastline aggregating 34 600 km (National Statistics Office, 1992). The climate is tropical and is within the cyclonic range of the southwesterlies during May through October each year. The country has a land area of 300 000 km^2, and inshore coastal water area of 266 000 km^2 and an offshore oceanic waters of 1 934 000 km^2 or total territorial water area of 2 200 000 km^2 (BFAR, 1993).

The country has a humid climate with rains averaging 1 500 mm per year mainly during May to October during the southwest monsoon, and relatively dry but milder weather during the northeast monsoon in November to April. The temperature ranges from 15° to 40°C, but mainly 25° to 33°C during most of the year.

The country has two major big islands, Luzon in the north and Mindanao in the south, several medium ones in the middle (i.e. Samar, Leyte, Negros, Panay, Cebu, Bohol, Masbate, Mindoro and Palawan), and several small islands and islets scattered all over the country.

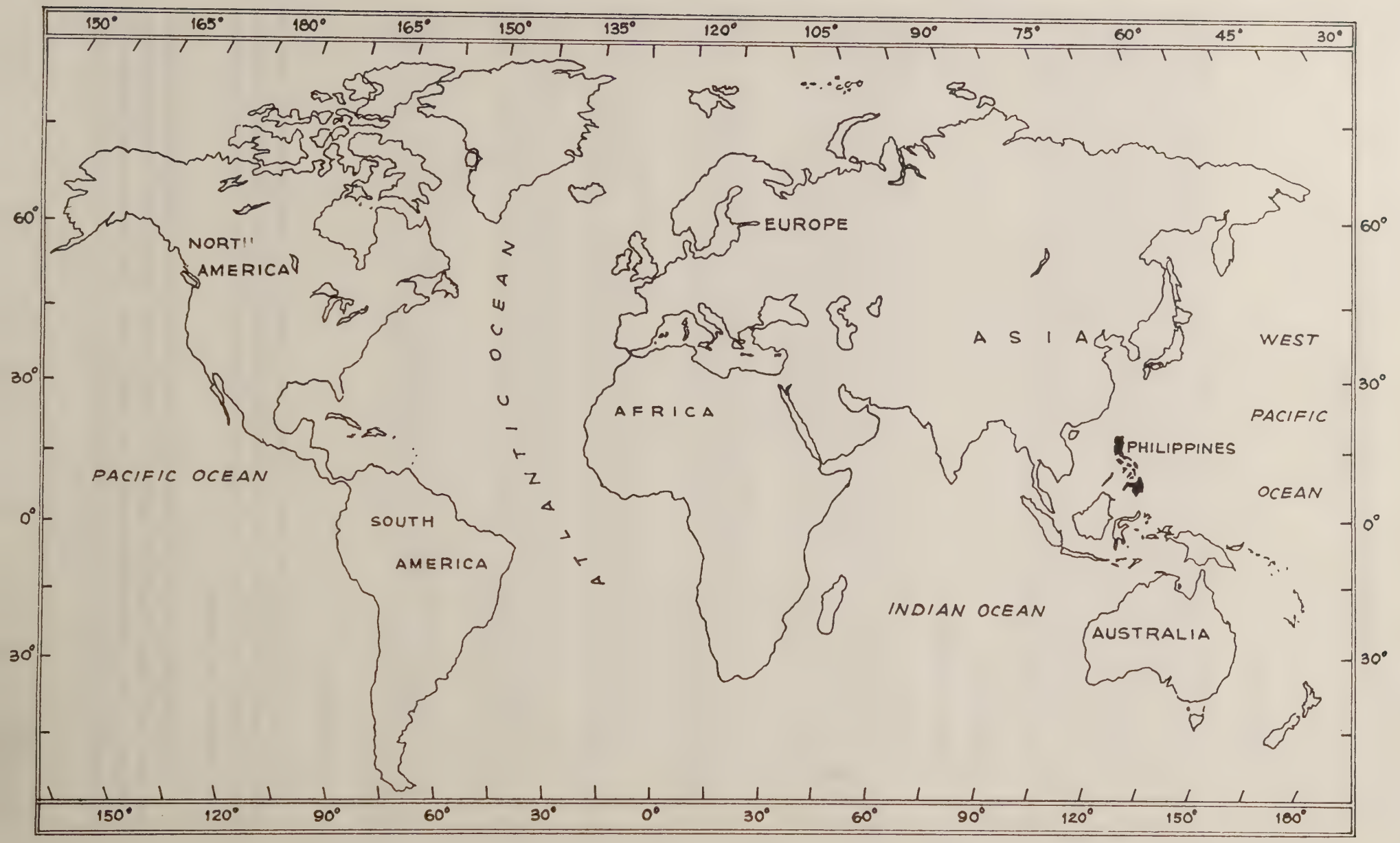
Most of the bigger islands have extensive lowland plains traversed by major rivers but in general the smaller islands and parts of the bigger ones have rugged rolling topography either forested or covered by grasslands. Most of the lowland plains are settled and have become centres of populations and development.

The country has many lakes and rivers: inland waters aggregate 600 000 ha (6 000 km^2). The surrounding seas are extensive, but in general the country has a narrow coastal shelf aggregating some 184 600 km^2, but the shelf drops down abruptly to the deep offshore waters (BFAR, 1994).

1.1.2 Demography

The country is well populated and this is fast growing. By latest estimate in 1991 the population stood at 62.1 million; but in 1993 it was estimated that the country had reached 65 million or a density of 217/km^2. The population is growing at the rate of 2.0 to 2.5 percent per year, a relatively fast growth.

From the 30s to the 70s the country enjoyed a relatively stable and progressive economy. This was mainly agricultural and based on few export crops such as sugar, coconut and hemp which used to enjoy preferential trade with the United States. This was probably the reason for its stable economy at the time. With continuing fast population growth and unchanged production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patterns the economy began a downtrend during the 80s and this state seems to be continuing during the present decade.

Inspite of the economic and demographic situation, the health and nutrition condition of the people have been placed at a good level compared with other developing countries of the world. It has a good health and nutrition programme and the agencies for this work are well established. Except for pockets with some deficiencies in some rural areas, the health and nutrition of the people are well placed. The major diseases are pulmonary, gastro-enteritic, cardiac diseases and malaria; but in general these are under control especially that of malaria. There are no serious cases of malnutrition and other diseases.

Education is emphasized and in general the population has a high rate of literacy at over 80 percent. Elementary education is free but secondary and tertiary education has to be paid for. The educational standards vary from very good to good, and poor in few places, but it can be claimed that this country enjoys a high standard and level of education comparable to most countries of the world.

Economy. - As mentioned the economy used to be good through the 70s. During the 80s a downward trend has taken place and continues to beset the country. Worldwide economic downtrend of most countries of the world and local economic and political changes have aggravated the Philippine economic situation. The preferential trade enjoyed for the country's major exports were removed and production of these commodities declined. This was further aggravated by the costs required for increased volume of public services to meet the needs of the growing population and to replenish and modernize the established industries. This situation is clearly shown by the country's Gross Domestic Product (GDP) which showed an average growth of 6.3 percent in 1975-1978, but then declined to 1.3 percent in 1980-1984 and to 2.1 percent during 1985-1994, still a low growth but with slight sign of recovery (ADB, 1992).

Social milieu. - Many years back (up to 1970s) the larger bulk of the country's population lived in the rural areas (70 percent). At present, however, records show that the rural and urban population are 50:50 or equal in number. There has been an exodus into urban areas due to greater prospects of employment as well as other amenities like presence of educational facilities, and other public services.

Philippine society is characterized by wide diversity. There are a few rich people, limited middle class, and a large number of poor people in the society. Many years of colonial status first under Spain (400 years), then under American rule (40 years) and a brief period of Japanese regime (two years) greatly affected the condition and economy of Philippine society. In addition, the people power political upheaval that took place in 1986 had a profound impact on the economy. This was followed by some very serious earthquakes and volcanic eruptions during recent years (1992-1993). Besides, the usual yearly typhoons further aggravating the situation. Some signs of economic recovery were visible during 1993-94.

The male and female components of Philippine population are equally divided with males slightly higher in rural areas while female numbers slightly predominate in urban areas. As a rule, Philippine society is dominated by the males but women play active supporting roles and more actively in recent years. Women today have the right of suffrage, and they are willing to assume positions of responsibility in government and in business. There are women in high executive positions, they play active part in politics as senators, congressmen, governors, mayors as well as in the judiciary as judges and justices. A woman president ruled after the people power revolution in 1986. They are active in the academic life, in business and in science and technology as well.

Philippine society is predominantly Christian with Catholicism as the main religion plus several christian protestant sects aggregating about 90 percent of the population. It is estimated

that about five percent are Muslims mostly located in the biggest southern island of Mindanao and the rest (five percent) is distributed in several smaller religious groups.

Power structure is democratic vested in political parties with a presidential government system. Three sets of power - the executive, the legislative and the judicial are coequal and provide checks and balances in the system.

Legal framework. - Lands are classified as disposable and non-disposable. Non-disposable lands belongs to the government and can be disposed for private ownership only upon reclassification by the government. Disposable lands can be disposed to the people who assume private ownership on them.

The waters of the country - the inland waters as well as the surrounding territorial seas are property of the state. The inland waters include lakes, rivers, reservoirs, swamps and marshes which are often applied for development as aquaculture sites. Development of any of these sites for aquaculture purposes are subject to licensing by the government wherein the applicant is granted permit or lease for a number of years (annually or for 10 to 25 year period) and often renewable. A schedule of fees is charged for these leases.

1.2 Capture Fisheries

Capture fisheries is the main source of fish production in the country (Dickson, 1993). Philippines being an archipelagic country with extensive surrounding seas and very long coastline, it is obvious that the fish supply would come mainly from capture fishing. Statistics taken during the 1940s through the 1970s showed that about 90 percent of the total fishery production were derived from capture fisheries while only 8 to 10 percent came from aquaculture (Table 3).

For purposes of administration, capture fisheries production is classified into:

a. Municipal fisheries, and
b. Commercial fisheries.

The municipal fisheries sector consists of the production from small fishing boats of less than three gross tons fishing in inland freshwaters or in coastal marine waters within seven miles from the coastline. The major fishing grounds are shown (Figure 2). This production comes from a large number of subsistence fishermen using low technology, and unsophisticated gear. But this production subsector has maintained its position as the major source of fish production in the country up to the present time (Table 4).

The commercial fishing subsector utilizes motorized fishing crafts of over three gross tons that operate at distances more than seven miles from the shoreline. Some of these boats have tonnages up to 1 000 or over gross tons and operate in offshore and deepsea waters.

The fish species that compose the bulk of resources caught around Philippine waters are two types, namely: (1) pelagic species; and (2) demersal species. The major pelagic species caught include the roundscads, sardines, skipjack, anchovies, and tuna (yellowfin, big-eyed and frigate). Other species also of major importance but caught in lesser quantities include the Eastern little tuna or bonito, the big-eyed scads, squids, round herring, flying fish, Acetes or small shrimps and Spanish mackerel. The major bulk of these pelagic species are caught by commercial fishing boats while some percentage are also caught by municipal or subsistence fishermen. The major gear used for commercial pelagic fishing are purse seine, long line and ring net. In shallow waters, pelagic fishermen utilize purse seine, ring net, surface and mid-water gill net, surface trawling, bag net and round haul seine.

The major demersal species caught around Philippine waters are the slipmouths, threadfin breams, groupers, goatfishes, cavallas, snappers, crevalles, blue crabs and mullets. Other species caught in lesser amounts include the porgies, siganids, hairtails, therapons, barracudas, white

shrimps, whitings, caesios, lizard fishes and croakers. Demersal fishing resources are caught on either soft- or hard-bottom part of the sea. The soft-bottom species include the slipmouths, goatfishes, croakers, whitings and lizard fishes which are caught by trawlers, fish traps, hook and lines and bottom gill nets. The hard-bottom species such as the snappers, siganids and groupers are caught by hook and line, bottom gill net and barricade nets using scare lines.

While capture fishing has been supplying the major bulk of fishery production, certain fishing grounds particularly the inshore coastal waters, have shown definite signs of over-exploitation and catch from them have tended to level off or even decline. This is clearly shown in the figures showing the annual levelling off of production from this sector. This is also shown by the fact that in the 40s to 60s and part of the 70s, the production from this sector was about 90 percent while that of aquaculture was only about 10 percent. During the late 1970s, however, the aquaculture sector gradually increased production to over 15 percent and this trend continued so that aquaculture has attained 28 percent of the total fisheries production in 1992 (Table 3).

1.3 Aquaculture

1.3.1 Status

The Philippines has a long tradition of aquaculture. During the 15th century foreign traders observed the existence of coastal fishponds in the country. For a long time, these coastal brackishwater fishponds represented the main aquaculture activities in the country. At that time, the increase in fishery production through capture fishery and brackishwater pond fish culture were gradually increasing hand in hand at a proportion of 9:1, respectively. It is in recent years, starting from 1960s and accelerating in the 1970s and especially in the 1980s that aquaculture expanded rapidly and diversified its production. Besides brackishwater fishponds; freshwater fishponds, molluscs culture (mainly of oysters and mussels), fishpen and cage- net culture of finfish and mariculture of seaweeds were developed. This resulted in substantial increase from a static annual production of only about 100 000 metric tons per year, to over 200 000 in the late 1970s to over 400 000 in the early 1980s, and 500 000 to 700 000 from 1985 to 1992. What is more impressive is the fact that the value of aquaculture products increased from only 25 percent in 1983 to 40 percent in 1992 (Table 4).

Focal areas of production. - The country is divided into 14 administrative regions [Regions 1-12 and the National Capital Region (NCR) and the Cordillera Autonomous Region (CAR) Figure 3]. In 1992, the major regions for aquaculture production were: - Western Mindanao or Region 9, 44 %, Central Luzon or Region 3, 13%, Western Visayas or Region 6, 11.7 %, Southwestern Luzon or Region 4, 11.6 %, Central Visayas or Region 7, 5 %, Northwestern Luzon or Region 1, 4 % and all the other regions (NCR, CAR, 2, 5, 8, 10 and 12) together, 10.7 %. The availability of suitable sites for development and the presence of entrepreneurs account for higher development of aquaculture in some of the regions.

Production under different culture systems and environments (Table 6). - Philippine aquaculture can readily be divided into six major systems and environment: (1) brackishwater fishponds; (2) freshwater fishponds; (3) fishpens mainly in freshwater; (4) fishcages mainly in freshwater; (5) seafarming for molluscs; and (6) seafarming for seaweeds. Although production from brackishwater fishponds has fluctuated, it still maintained the highest position in production as well as value with production of 234 875 mt valued at PPs 19.3 billion in 1992. In the same year, the production volume and value for the other systems are: freshwater fishponds - 48 752 mt valued at PPs2.2 billion; fishpens - 33 395 mt, PPs1.3 billion; fishcages - 34 292 mt, PPs1.2 billion; molluscs - 35 562 mt, PPs449 million; and seafarming for seaweeds -349 505 mt, PPs1.5 billion (Table 5).

Major species cultured (Table 6). - Six major species groups stand out as the main aquaculture candidates in the country. These are milkfish, tilapia, jumbo tiger shrimp, oysters, mussels and seaweeds. Based on 1992 statistics, the production of milkfish was 145 554 mt

valued at PPs5.8 billion; seaweeds - 349 505 mt, PPs1.5 billion; jumbo tiger shrimp - 75 996 mt, PPs12.5 billion; tilapia - 48 006 mt, PPs2.2 billion; mussels - 20 458 mt, PPs278 million; oysters - 15 103 mt, PPs170 million. Here, it should be noted that seaweed production is highest in volume but that of the jumbo tiger shrimp is highest in value. The volume of production and value remained high for milkfish.

1.3.2 Potentials

Given the proper environment for growth, the Philippine aquaculture industry still has high potentials for accelerated expansion and development. The freshwater fishpond industry is underdeveloped and can expand and improve its production per unit area. Mariculture of cultivable marine species has the greatest prospects for further expansion. The cultivation of different species of economic seaweeds can expand rapidly if there is demand and market prices are favourable. Likewise, mariculture of shellfish including various species of oysters, mussels and other bivalves, can also increase. Fishpen culture in protected marine areas and netcage culture in both freshwater and marine situations can further expand. There are some scope for intensification of production in both freshwater and brackishwater ponds. Diversification of species used for culture has good prospects for species like catfish and prawns besides tilapia and the carps in freshwater ponds; groupers, giant perch, snappers, siganids, other penaeids besides milkfish and the tiger shrimp in brackishwater ponds; and high value finfishes (groupers, snappers, giant perch) in marine netcages and pens.

1.3.3 Problems and constraints

Inspite of the seemingly accelerated expansion of the aquaculture industry, it is beset with problems and constraints. These may be divided into: (1) technical; (2) administrative and management; and (3) economic (Rabanal, 1991).

Of the technical problems the following may be mentioned:

a. lack or insufficiency of basic biological information on the life history and biology of the cultivated species;
b. lack of appropriate technology for cultivable species;
c. shortages of seeds for stocking;
d. inadequate knowledge of disease prevention and control;
e. inadequate provisions to solve or meet adverse environmental impacts on aquaculture development and management.

The administrative and management constraints include:

a. lack of coordinated national policy and administrative support for aquaculture development;
b. inadequacy or lack of inputs required for aquaculture farm operations;
c. inadequacy or lack of properly-trained managers, technicians and skilled labour;
d. conflicting demand on the use of land and water required for the development of aquaculture;
e. inadequate or lack of institutional support at various levels for aquaculture development; and
f. legal constraints to aquaculture development.

The economic constraints include:

a. lack of demand or market for the cultured product; and
b. lack or inadequacy of credit for development and operations

1.3.4 Government plans for development and on-going development activities

Before the people's power revolution in 1986, the economic condition of the country was very depressed so that the programmes in this sector were not making much progress. After the revolution and a new regime took over, the government initiated a programme based mainly on alleviating the poverty of the people. This was appropriate during the period because of the general condition of poverty existing in the country. However, due to continued depressed economy and the unstable political condition during the period, this new programme did not make much headway either. In 1992, a general election was held and a new set of officials were installed in the government. This new government which is, at present, in power (1993-1998), put up a National Medium-Term Economic Development Plan under which a National Medium-Term Fisheries Management and Development Plan (MTFMDP) is included (Anonymous, 1993). This is an ambitious programme in fisheries including that of aquaculture. It is designed to optimize the contribution of the fisheries sector towards making the Philippines a newly-industrialized country (NIC) by the year 2000. The major thrust of this programme is to optimize the contribution of fisheries production especially those considered export winners so that they could attain or maintain their international competitiveness in the world market. The aquaculture sector is expected to contribute in the production of some of these products from its finfish, crustacean, molluscan and seaweed resources. Of course, the government is still suffering from difficult economic conditions but it has put up strong determination to overcome these adversities. Peace and order conditions have improved, improvement of transportation and telecommunications and other essential services and facilities are also expected to improve.

Specifically in the field of fisheries including that of aquaculture, the government Department of Agriculture (DA) is mainly responsible in carrying out the programme of agricultural development including that of the fisheries sector. The DA Regional Offices carry out the development and administrative programmes on fisheries in the field in cooperation with local government units (LGUs) (regional, provincial and municipal).

The DA, through its various agencies, specially the Bureau of Fisheries and Aquatic Resources (BFAR), Bureau of Agricultural Research (BAR), Bureau of Agricultural Statistics (BAS) and the Agricultural Training Institute (ATI) all cooperate towards development of aquaculture in their respective sector of work. The DA through BFAR and BAR, is executing an Asian Development Bank (ADB) Loan-supported Fisheries Sector Program (FSP) (Anonymous, 1993a). The main thrust of this Program is the management of coastal fishery resources through extensive studies and management of selected Philippine bays which have been found to be depleted of their fisheries. But this Program also includes research and development studies on aquaculture particularly on resources that have potentials for development to supply the needs of the country and for exports.

Besides national programmes, there are bilateral and multilateral technical assistance projects which aim to develop certain aquatic resources through aquaculture. This includes the UNDP-FAO Seaweed Production Development Project. The European Union is implementing the ASEAN Aquaculture Development and Coordination Project, the ICLARM-CLSU-BFAR has just completed the Genetics Improvement of Farmed Tilapia (GIFT) project - all designed to solve specific aquaculture problems now existing in the country.

Two multinational non-governmental organizations, the Southeast Asian Fisheries Development Centre/Aquaculture Department (SEAFDEC/AQD) and the International Center for Living Aquatic Resources Management (ICLARM) are based in the Philippines and in many of their projects in fisheries and aquaculture the country is involved (Table 8).

Educational institutions both public and private established in the country have strong involvement in fisheries and aquaculture and are active in putting up studies and activities concerning this sector. These include the University of the Philippines in the Visayas (UPV), the Central Luzon State University (CLSU) and other state colleges and universities (SCUs). Even

private colleges and universities are also active in fisheries and aquaculture work. These include the San Carlos University in Cebu in central Philippines and the Xavier University in Oriental Misamis province in Mindanao, southern Philippines.

2. FISHERIES/AQUACULTURE INSTITUTIONS

2.1 For Development and Management

2.1.1 Institutions and their organizational structure

The national government agency responsible for fisheries and aquaculture development and management is the former Bureau of Fisheries which was created by Republic Act No. 177, approved in 1 July 1947. It had among the various units under its supervision, the Philippine Institute of Fisheries Technology (PIFT) and seven secondary fishery high schools. This set-up obviously demonstrated the intention of the government to develop fishery manpower for servicing the fishery industry. This agency was under the Department of Agriculture and Natural Resources (DANR).

In 1957, government reorganization took place and the fishery educational function of the Bureau was transferred to other government institutions. The PIFT was absorbed by the University of the Philippines which is now the College of Fisheries of that University; the secondary fishery schools were transferred to the Bureau of Public Schools under the then Department of Education, now called Department of Education, Culture and Sports (DECS).

In 1963, the Bureau of Fisheries was abolished and replaced by the Philippine Fisheries Commission (PFC) by virtue of Republic Act 3512. The duties and responsibilities of this new fishery organization were essentially the same as the Bureau but the functions were more defined and expanded. It had 12 regional offices which served as the outreach network of the PFC nationwide.

Its structure, besides the various technical and administrative divisions, had an Advisory Committee on Fisheries and Allied Matters. This Committee was intended to provide the mechanism of interaction and dialogue between the public and the private sector to iron out fishery/aquaculture industry problems with the government.

There was a shift in the form of government from presidential to quasi-parliamentary system after Martial Law Declaration in 1972. Several changes took place affecting the fishery sector. In 9 November 1972, Presidential Decree No. 43 created the Fishery Industry Development Council (FIDC). The main functions of this Council were to provide comprehensive policy guidance and create a healthy investment climate for the development of the industry in all aspects; and to delineate and coordinate the various activities of the participating agencies, both public and private sectors. The PFC became the implementing arm of the FIDC.

Another Council, the Philippine Council for Agricultural Research and Resources Development (PCARRD) was created by a Presidential Decree also in 1972. This Council was the central coordinating agency for approval of all government-sponsored agriculture and natural resources research. It did not only approves but also assisted in planning, raising funds, developing research capability and publishing research results.

PCARRD had a Fisheries Research Division which coordinates fishery research activities. Subsequently, the Fisheries Research Division of PCARRD became an autonomous body by itself which is now called the Philippine Council for Aquatic and Marine Research and Development (PCAMRD).

In May 1974, Presidential Decree 461 split the Ministry (formerly called Department) of Agriculture and Natural Resources (formerly DANR) into two ministries, namely the Ministry of

Agriculture and Food (MAF) and the Ministry of Natural Resources (MNR). Under this set up, the Philippine Fisheries Commission was renamed the Bureau of Fisheries and Aquatic Resources (BFAR) and was retained under the MNR. The FIDC was attached to the Office of the Minister of the MNR who served as its Chairman. The organizational structure of the BFAR at that time is shown (Figure 4).

In the early 1970s the policy of government was to accelerate agricultural development. It sought the assistance of the World Bank to strengthen its capability to coordinate the delivery of extension services as this aspect was identified as the main bottleneck in the MAF's organizational structure to pursue agricultural development with greater pace and efficiency.

In this connection, the National Extension Project (NEP) was formulated and a loan from the IBRD was approved by the World Bank (WB) and the government signed the Loan Agreement 1626 PH in 21 December 1978. This Project became operational in 1979 and was terminated in 31 December 1985.

The major change brought about by this Project was the reversion of the BFAR to the Department of Agriculture (DA) effective 1 July 1984. The FIDC was abolished. All the other bureaux under the DA including BFAR were reduced to staff functions as shown in Figure 5. Their line functions were taken over by the regional offices. As a consequence of this transfer the functions of BFAR were fragmented. All its regional offices were merged with the DA regional offices where the major agricultural services were assigned to cereals, other crops and livestock.

Pantaleon (undated) in her report on the assessment conducted on the implementation of the NEP reported that the reorganization of the structure of the government agencies concerned contributed largely to the numerous problems in the implementation of the project in fisheries, this hampered attainment of goals and targets. On the whole, the reorganization of the DA adopting the WB/IBRD concept of implementation was not successful.

In 1986, the Martial Law Regime was toppled. A year later the new government issued Executive Order No. 116 which retained the staff functions of BFAR and the other bureaux. BFAR's functions are limited to the following:

a. Formulate plans for the proper management, accelerated development and proper utilization of the country's fishery and aquatic resources.
b. For the above purposes, undertake studies on the economics of various phases of the fishing industry to form the bases for the formulation of policies and programmes on fisheries and aquatic resources.
c. Render technical assistance and advisory services on the proper procurement, construction and operation of fishing vessels as well as determination and designation of fish landing points for all commercial fishing boats.
d. Recommend plans, programmes, policies, rules and regulations to the Secretary of Agriculture and provide technical assistance in the implementation of the same.

By virtue of the foregoing reorganizations of the government, fragmentation of BFAR's functions took place, drastically cutting the linkage of national fisheries/aquaculture development planning and extension at the field level. While it could formulate plans, implementation of the same in different parts of the country were not well coordinated at regional level due to lack of guidelines in the course of reorganizations.

There were subsequent reorganizations which took place due to economic circumstances. The government policy of reducing government expenditures led to reduction of manpower in the BFAR. Consequently, restructuring of the agency was inevitable. From 14 divisions in the past, this was reduced to nine divisions as shown in Figure 6. Former regional fisheries workers were transferred to the regional offices of the DA. They were further devolved to the Local Government Units by virtue of the new Local Government Code. The implementation of this Code is at present

in the process of readjustment. The contacts between the BFAR and the field have now become more often.

2.2 For Research (With Special Reference to Aquaculture)

2.2.1 The Aquaculture Division of BFAR

The BFAR has an Aquaculture Division which is responsible for the formulation and implementation of aquaculture development and research programmes.

It has under it the Sections on Freshwater Fisheries, Brackishwater Fisheries, Mariculture and Fish Health. In addition, the BFAR maintains and operate the National Freshwater Fisheries Technology Research Center, located in Muñoz, Nueva Ecija province; the Tanay Freshwater Experimental Station in Tanay, Rizal province; and the National Brackishwater Aquaculture Technology Research Center, located at Pagbilao, Quezon province all in Luzon island (Figure 6).

The BFAR, through these facilities, implements genetic research on tilapia in cooperation with the International Center for Living Aquatic Resources Management (ICLARM); and research in brackish-water aquaculture with the European Union ASEAN Aquaculture Development and Coordination Programme (AADCP).

2.2.2 The Aquaculture Department (AQD) of the Southeast Asian Fisheries Development Center (SEAFDEC)

This is a regional institution established by an Agreement between Japan, Singapore, Thailand, Malaysia, Philippines and Viet Nam. The latter country (Viet Nam) has not been an active member since its establishment in 1973.

The AQD is one of the three departments of SEAFDEC. It is hosted by the Philippines and based at Tigbauan, Iloilo province in Western Visayas in the middle Philippines. The Department is headed by a Chief nominated by the Philippine Government and a Deputy who is a Japanese by virtue of its Charter.

It implements an aquaculture research programme as approved by its Governing Council. The Philippine Government provides the annual cost of maintenance and operation of the Department. This is supplemented by research grants from donor institutions abroad.

The activities of the Aquaculture Department may be gleaned from its organizational structure shown in Figure 7.

2.2.3 Philippine Council for Aquatic and Marine Research and Development (PCAMRD)

As previously mentioned the PCAMRD used to be the Fisheries Research Division of the PCARRD. It was established by virtue of Executive Order 128 in 1988. The Council is one of the sectoral planning councils of the Department of Science and Technology (DOST).

Its functions are primarily the formulation of research programmes; and coordination, monitoring and evaluation of research activities. It is also empowered to generate funds for research from external sources. The organizational structure of this Council is shown in Figure 8.

2.2.4 International Center for Living and Aquatic Resources Management (ICLARM)

ICLARM was originally a private organization funded mainly by the Rockfeller Foundation. It was incorporated in 1977 and established its headquarters in Manila. This organization obtains funding from bilateral and multi-lateral sources.

ICLARM's mandate has been to complement and support the activities of national and regional research systems in capture fisheries and aquaculture. Since 1986, this mandate has been broadened to include aquatic aspects of coastal management.

In November 1990, ICLARM prepared a long-term strategic plan of research as part of the process to join the Consultative Group on International Agriculture Research (CGIAR). The strategic plan has been endorsed by the Technical Advisory Committee (TAC) and ICLARM finally was admitted into the CGIAR system in May 1992.

In 1993, ICLARM was reestablished as an international organization. An agreement was signed between the governments of the Philippines, Malawi, Denmark and Viet Nam. This legitimizes or secures its legal foundation to negotiate agreements with various countries to host its research stations and project offices (INFOFISH, 1993).

ICLARM's programmes include aquaculture, capture fisheries management and an information programme (Table 7). In the Philippines the institution is involved in coastal area management and aquaculture.

Under the Strategic Plan as approved by the CGIAR in 1992, the programmes are restructured which will reflect a systems approach. These new programmes are:

a. Inland aquatic systems;
b. Coastal resource systems;
c. Coral reef resource systems; and
d. National research support programmes.

2.2.5 Marine Science Institute, University of the Philippines, Diliman, Quezon City, Metro Manila (MSI-UP)

This Institute provides academic training in marine sciences as part of the curriculum of the UP's education programme in the field of marine biology and oceanography.

It has a strong marine research programme particularly on corals and reef fisheries including seagrasses and seaweeds. Facilities for this purpose are located in Bolinao, Pangasinan province, Luzon, which serve as the marine research and training center of undergraduate and graduate students in marine science.

2.3 For Education and Training

2.3.1 The College of Fisheries, University of the Philippines, Visayas Campus (UPV), Miagao, Iloilo province

This College was the former PIFT attached to the Bureau of Fisheries in the 1950s. It is the premier institution for fisheries education in the country.

It has three major undergraduate degree courses namely, marine fisheries, inland fisheries and aquaculture, and fisheries technology. Recently, the College opened graduate courses in these major fields. The majority of fisheries graduates in the government service are products of this College.

There are also several government and private institutions in different parts of the country which offers fisheries courses. Some of these are the following:

a. Bicol University in Tabaco, Albay province;
b. Central Luzon State University, Muñoz, Nueva Ecija province;
c. Mindanao State University in Marawi City, Mindanao island;

d. Zamboanga State College of Marine Science and Technology, Zamboanga City in Mindanao;
e. Don Mariano Marcos Memorial State University, Sto. Tomas, La Union province;
f. Silliman University in Dumaguete City, Negros island in middle Philippines;
g. University of San Carlos in Cebu City, Cebu island;
h. Xavier University in Cagayan de Oro City, Mindanao island; and
i. A number of other State Colleges and Universities (SCUs) in scattered locations in the country.

3. AQUACULTURE EXTENSION SERVICES

3.1 Extension Services Organization (Tamesis, 1987)

3.1.1 Past organization of aquaculture extension services and changes

Aquaculture extension service in the Philippines dates back to the 1930s. At that time, it was implemented by the Section of Fisheries of the then, Fish and Game Administration. In 1 July 1947, the Bureau of Fisheries was created by Republic Act No. 177. At that time, the Bureau's service on aquaculture extension consisted mainly of fishpond development by rendering technical assistance to fishpond owners. The assistance given covered site inspection to determine the suitability for fishpond purposes; supervision during fishpond construction and stocking; advice on appropriate culture methods; and proper harvesting and handling techniques.

As mentioned earlier, in 1964, the Bureau of Fisheries was converted into the Philippine Fisheries Commission which continued to carry over the extension functions for the different sectors of fisheries including aquaculture.

In 1972, under Presidential Decree No. 43 the Philippine Fisheries Commission was renamed Bureau of Fisheries and Aquatic Resources (BFAR) to undertake or arrange special technical assistance and training programmes for the enhancement of the fisheries industry and provide assistance to fishery educational institutions in their research and instructional activities. To carry out these tasks, the Fisheries Extension Division and Fisheries Training Division under BFAR were created in 1975.

The Fisheries Training Division was not directly involved in fisheries extension work but it looked after the training of trainers some of whom were involved in extension services. It assessed the manpower requirements of the fisheries industries and established linkages with educational and training institutions so that the needs in fisheries were covered. It was also involved in the preparation of training and information materials and in planning, monitoring and evaluation of fisheries training programmes. Because of these functions it had to coordinate very closely with the Fisheries Extension Division.

The Fisheries Extension Division of the BFAR directed its efforts towards better and improved fish production. Thus, all projects and activities primarily sought to promote increased production through effective technology transfer.

Fisheries extensionists assisted people in the fishing industry in improving farming, fishing and processing techniques. To accomplish these tasks, the educational or teaching approach was emphasized, using one or combination of the individual, group or mass media methods to get the message across.

The extension functions of BFAR up to 1986 were implemented by the Fisheries Extension Division through the 13 regional offices with a total manpower complement of 700 extension officers. Of this, 320 were assigned to render aquaculture extension services. These field extension officers were supported by the national extension specialists through planning and

evaluation of the extension programmes, training and packaging of technologies, and advisory services.

The series of government reorganizations and the subsequent changes in the fisheries organization had adverse effects when in 1987 under Executive Order 116 the BFAR was transformed from a line to a staff agency. As a staff bureau the extension functions among others were transferred to the regional offices of the Department of Agriculture (DA). As a result, the BFAR personnel assigned at the regional offices were placed under the direct supervision of the DA.

The implementation of Executive Order 116 in January 1987 turned the fisheries extension workers into generalists and they were referred to as Agricultural Technicians (ATs). Although the shift was aimed at improving effectiveness of the delivery of the agricultural extension system, the abrupt implementation caused disorientation. Moreover, specialized knowledge on fishery resources was a vital requirement in order to understand the various disciplines of the sector. An effective generalist extension approach should have been coupled with substantial training in fisheries, which was not done. To complicate matters, the improper deployment of individual extension workers had led to the unavailability of extensionists to respond to specific concerns of the clients on fisheries which were not within their field of expertise.

3.1.2 Present set up: Department of Agriculture (DA), Fisheries Extension Delivery System

The central and field organization of the aquaculture extension service will be discussed under the Fisheries Sector Program (FSP) and National Fisheries Outreach Program (NFOP) schemes of the Department of Agriculture.

a. Fisheries Extension - FSP Scheme, 1990 (Figure 9)

The Fisheries Sector Program (FSP) is an inter-agency programme to rehabilitate, conserve and regenerate the fisheries resources while at the same time alleviating the poverty level of the marginal fishermen. This Program started operation in 1989 with funding loan from the Asian Development Bank (ADB). Its operation is scheduled to terminate in 1994-95 with the possibility of further extension.

To facilitate the implementation of the activities of the various agencies, the DA created the Project Management Office (PMO) as an overall coordinating body to manage the Program. Subsequently, Regional Fisheries Management Units (RFMUs) for the different regions of the country (Figure 9) and Provincial Fisheries Management Units (PFMUs), respectively headed by the Special Assistant for Fisheries Development (SAFD) and Provincial Agricultural Officers (PAO), were established to implement the various sectoral projects under the major program components (Figure 9).

To institutionalize and implement the FSP activities, the DA relies on regular DA employees who are fisheries specialists or agricultural technologists with fisheries background. However, it appears that there are not enough specialists at present who can handle the planned activities on a full time basis because of their other responsibilities. It is hoped that after some period of adjustments, the number of specialized fisheries extensionists can be provided where they are most needed.

b. The National Fisheries Outreach Program (FSP-LGC Scheme) (Figure 10)

With the FSP in place and the Local Government Code (LGC)[1]2 in full implementation, which calls for the total phase out and devolution of the DA Regional Offices, all efforts consistent to the sustainable and equitable management of renewable fishery resources should continue to be carried out by the initiative of either the national or local government with the full participation and cooperation of Non-Governmental Organizations (NGOs) and the fishing communities. Activities are at present linked with FSP scheme of 1990 but the following scheme will continue to be carried out when the FSP terminates (Bureau of Agricultural Research, 1991).

i. Structure and functions

The DA Provincial and Municipal Offices will cease to exist. It is mandatory that the Provincial Agricultural Officers (PAO) are retained but the Municipal Agricultural Officers (MAO) may or may not be retained depending on the discretion of the Municipal Head, the Mayor, thereby reducing the authority of the RFMUs and the PFMUs as extension implementors in the field. To solve this problem, Memorandum of Agreements (MOAs) between the DA and the Department of Interior and Local Government (DILG)[2] are drawn and agreed upon by both parties. The MOA ensures that the PFMUs are maintained in each province to oversee the rational development, utilization and management of aquatic resources in their respective areas. The activities of the PFMUs will be supported by the Local Government Units (LGUs). Furthermore, the LGUs will include among their priorities the wise management of aquatic ecosystems. Bay Management Councils (BMCs) are also to be established where needed and local fishery legislations and policy directions are to be formulated under the guidance of the national government.

ii. Extension personnel: Composition of the Provincial Fisheries Management Unit (PFMU)

The PFMU will be composed of a team leader and several Community Fishery Officers (CFOs). Each municipality will have at least one CFO who will handle fishery activities and projects. The CFOs will be assisted by the Agricultural Technologists (ATs) in implementing fishery programmes in the community. The PFMU will be a regular unit under the Provincial Agricultural Officer (PAO) and will continue to exist beyond the life of the projects/programmes in order to ensure that proper management of local aquatic resources is pursued continuously.

PFMU administration. - The DILG through the PAO will super-vise the PFMU. However, the DA will supervise the technical aspects of FSP projects implemented by PFMU. Upon termination of the FSP, the PFMU will continue developing and promoting the management of aquatic resources under the PAO's supervision. They may also be tapped by the DA for other nationally or inter-nationally-funded projects administered by the DA.

The salaries of PFMUs will be paid by the national government to ensure that the units are retained especially in localities where they are most needed.

iii. Educational background and training

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[1] A law passed and approved in 1991 provided for a Local Government Code. This Law provides for increased autonomy and authority of Local Government Units (LGUs) including those on public services such as fisheries and aquaculture.

[2] The Department of Interior and Local Government or DILG is the executive branch of the government that supervises Local Government Units (LGUs) from regional, provincial, municipal and barangay (village) levels.

Majority of the field personnel doing aquaculture extension services are graduates of Bachelor of Science in Fisheries or related sciences and/or holders of Diploma in Fisheries which is a 2-1/2 or 3-year course in either fish capture, fish culture or fish processing. By virtue of their background and previous experience they are trained for their work.

iv. Rural organizations and their relationship with the aquaculture extension (Anonymous, 1993a)

Under the Republic Act 7160, also known as the Local Government Code of 1991, the management of coastal or municipal waters has been placed under the jurisdiction of municipal governments.

Section 3, item(i) states: "Local government units shall share with the national government the responsibility in the management and maintenance of ecological balance within their territorial jurisdiction, subject to the provisions of this Code and national policies".

Section 17, (Basic Services and Facilities) item(b) number 3(i) states: "Agricultural extension and on-site research services and facilities; and assistance in the organization of farmer's and fishermen's cooperatives and other collective organizations, as well as the transfer of appropriate technology".

Besides the involvement of local government units (down to the village level), private organizations have also been organized and these have started to take active part in rural development and livelihood projects. Some of these involve fisheries and aquaculture and other aspects of agricultural production.

3.2 Extension Policy, Plans and Programmes

The aquaculture extension policies, plans and programmes are embodied in the Medium Term Fisheries Management and Development Plan (MTFMDP) (Anonymous, 1993) and complemented by the mandates for the Fisheries Sector Program (FSP) and the National Fisheries Outreach Program (NFOP) of the DA.

3.2.1 Government policies

The MTFMDP 1993-1998 is the basic framework for development policy making to attain sustainable and sound management and development of the country's fisheries and aquatic resources.

a. Policies

The primary policies to be pursued over the MTFMDP are: (1) enhancement of the overall productivity of our fisheries and aquatic resources within ecological limits; and (2) upliftment of the socio-economic conditions of the small-scale fisherfolks.

In particular, the specific objectives to attain under the above policies are the following:

a. To double aquaculture productivity from 1.2 metric tons/hectare/year to 2.4 metric tons/hectare/year
b. To double priority bays/gulfs for coastal resource management implementation from 12 to 24
c. To improve operating efficiency of fishing fleet by seven percent and according to international standards
d. To organize fishery law enforcement and provide support facilities to 50 percent of coastal municipalities
e. To reduce post-harvest losses by five percent and promote value-added products.

On the total demand for fisheries products in the country in the next seven years, it is projected that it will increase by 2.9 percent annually, from 2.71 million mt in 1992 to 3.22 million mt in 1998. About 95 percent of this will be used domestically while the rest will be exported. Domestic demand will increase from 2.57 million mt in 1992 to 3.1 million mt in 1998, an annual growth rate of three percent. Export demand on the other hand, will grow by nine percent per year, from 141 thousand mt in 1992 to 250 thousand mt in 1998.

Moreover, the domestic production of fisheries products is targetted to increase by 3.8 percent annually during the Plan period, from 2.7 million mt in 1993 to 3.3 million mt in 1998. The main contributors of this output will come from Southwestern Luzon (Region 4), Western Mindanao (Region 9) and Western Visayas Region (Region 6), which will account for an average of 27.8 percent, 25 percent and 13.5 percent of the country's total fisheries production, respectively.

Most of the increase of the country's production will come from commercial fisheries (the major fishing grounds are shown in Figure 2). Output in these areas will increase from 0.80 million mt in 1993 to one million mt in 1998, with an annual increment of four percent. Total catches of 38.2 percent, 19.1 percent and 14.1 percent will be landed in Southwestern Luzon, Western Mindanao, and Western Visayas Regions, respectively.

The rest of the country's fisheries output will come from aquaculture, which will be the fastest-growing of the three fisheries sectors. Production from this sector will grow at 5.8 percent per year, from 0.74 million mt to one million mt, during the Plan period from 1993 to 1998. Western Mindanao, Southwestern Luzon, and Central Luzon Regions will account for the majority of this output, contributing 41.6 %, 18.6 % and 16.1 %, of the country's aquaculture output, respectively.

3.2.2 Plans and programmes for fisheries and aquaculture development

a. Current programmes

To ensure the long term sustainability of the resource bases, production from traditional marine and inland fishing grounds will be increased within ecological limits.

The major coastal marine development areas to be managed to enhance their production are the following:

FSP Covered	Additional Bays
Manila Bay	Lingayen Gulf
Calauag Bay	Balayan Bay
Tayabas Bay	Albay Bay
Ragay Gulf	Sapian Bay
Lagonoy Gulf	Maqueda and Villareal Bays
San Miguel Bay	Butuan Bay
Sorsogon Bay	Gingoog Bay
Carigara Bay	Malampaya Sound
San Pedro Bay	Sibuguey Bay
Ormoc Bay	Illana Bay
Sogod Bay	Sarangani Bay
Panguil Bay	Davao Gulf

Additional Areas
Islands of Region VII
Sulu Archipelago
Celebes Sea
Sulu Sea

Aquaculture which will be a major source of increased production in the fisheries sector will adopt specific plans and programmes to attain the projected targets. In general, production from brackishwater ponds will be increased through the promotion of semi-intensive or other yield-increasing technologies within ecological limits. Freshwater aquaculture production will be increased by encouraging area expansion, genetic improvement of cultured species, promoting increase in stocking rates and culture of high yielding varieties. Fishpen and fishcage culture will be extended to include protected marine areas. Seafarming of shellfishes, finfishes, crustaceans and seaweeds will be initiated and expanded in suitable areas.

Specific policy directions, plans and programmes for the different key resources as formulated are given below (Reyes, 1993):

a. Milkfish and shrimp

i. Policy directions
- Support exemption of fishponds from the application of the Comprehensive Agrarian Reform Law (CARL).
- Strengthen Fisheries Lease Agreement (FLA) as a negotiable instrument in application for credit.
- Promote semi-intensive culture of finfishes.
- Support lower tariff rates for imported feeds and feed ingredients.
- Revision of Fishpond Lease Agreements (FLA) fees to reflect equitable rent.

ii. Projects

The strategic directions for improving productivity of milkfish and shrimps will focus on the following:

- Commercialization of milkfish hatchery technology.
- Government-private sector development of milkfish broodstock in ponds.
- Promotion of milkfish fishpen culture in marine waters.
- Support of continued research on milkfish broodstock, hatchery, nutrition and fry handling.
- Intensified extension services on semi-intensive culture using environment-friendly technology.
- Research on diseases and environment.

b. Tilapia and carp

i. Policy direction
- Continue genetic improvement of tilapia and carp.

ii. Projects

As potential areas for growth in fisheries, additional freshwater areas will be targetted to increase production. The efforts will be focused on the following:

- Programmes for genetic improvement.
- Promotion of polyculture methods.
- Management of major inland waters.

c. Seaweeds

i. Policy directions
- Promote Philippine Natural Grade (PNG) carrageenan.

- Develop and improve genetic quality of seaweeds.
- Diversify seaweeds products.

ii. Projects
- Genetic improvement of *Eucheuma* spp.
- Stock assessment of seaweed resources.
- Development of farming technology.

d. Crabs

i. Policy directions
- Resource assessment and management.
- Seed production.

ii. Projects
- Nationwide assessment and management of crab resources.
- Seed production and hatchery technology.

3.2.3 Funding

a. Government funded

The whole MTFMDP is estimated to cost 19.209 billion pesos. Aquaculture development will require 5.396 billion pesos or 28.9 percent of the total Plan cost (Table 8). These are all government funded.

b. External aid-funded

The Fisheries Sector Program (FSP) is funded mainly through a loan from the Asian Development Bank (ADB) with counterpart funding from the Philippine government. This Program has six components, namely: (1) Coastal Resource Management; (2) Fishery Resource and Ecological Assessment; (3) Credit; (4) Law Enforcement; (5) Post-Harvest Infrastructure and Marketing; and (6) Research and Extension Component (REC). The National Fisheries Outreach Plan will implement the extension plan for FSP.

The United Nations Development Programme (UNDP) through the Food and Agriculture Organization of the United Nations (FAO/UN) is funding two projects, each of which has some fisheries extension component. These are the: (1) Seaweed Production Development Project; and (2) Improving the Status of Disadvantaged Women in Small-Scale Fishing Communities.

From the European Union (EU) the regional aquaculture project, the Asean Aquaculture Development and Coordinating Programme (AADCP) has activities in two centers in the Philippines, one in Muñoz, Nueva Ecija province in Central Luzon and the other in Pagbilao, Quezon province in Southwestern Luzon.

c. Private-funded

The private operators in aquaculture in the Philippines are well organized. Although not in very active status, there is a National Federation of Aquaculturists, regional aquaculture federations, and some provincial societies. These local societies, provincial and regional federations often donate funds to carry out research on specific subjects with institutions of higher learning (universities, e.g. the University of Philippines in Visayas or UPV).

A private foundation whose members are aquaculture practitioners, the Fishfarmers Technical Assistance Foundation, Inc., raises funds to carry out practical training for aquaculture managers, technicians and skilled labourers in the industry.

3.3 Methods and Systems of Extension (Legaspi, 1993)

Aquaculture extension services cover both the brackishwater and freshwater fishponds, ricefish culture projects, seafarming projects, fishpens and fishcages, mariculture for molluscs and seaweeds and other related endeavours involving husbandry and culture of aquatic animals and plants.

Specifically, the methods employed by the aquaculture extension workers are as follows:

3.3.1 Description of methods and systems

a. Individual methods

The individual extension methods employed by the aquaculture extension workers are:

- Office calls. - Individual office callers are given one-on-one technical advice by the specialists or extension officers who are based in the national, regional, provincial or municipal offices.
- Letters/inquiries. - Clients who are far from the office of the extension workers sometimes send letters of inquiry or to request for technical brochures.
- Home/field visits. - Upon request, home or field visits are also employed by the extension workers. However, targetted cooperators are regularly visited by the extension workers.
- Demonstrations. - In conjunction with home/field visits, if called for, methods or result demonstrations are also used by the extension workers.

b. Group methods

The group methods used include the following:

- Meetings. - Meetings either initiated by the government or by the private sector is commonly used extension method to disseminate information and to transfer new techniques and practices.
- Demonstrations. - Method and result demonstrations are usually employed in teaching new techniques in aquaculture. This is usually done in the demonstration farms/centers.
- Trainings/workshops. - Trainings and workshops are commonly used in the transfer of newly developed technologies. Such trainings are usually done in the training centers.

c. Demonstrations

To provide suitable show window for aquaculture technologies that have been developed for the different cultivable resources, the government usually put up projects or demonstration farms in strategic areas in the country. Interested citizens who want to start such projects or those already engaged in the same type of activity are welcome to visit such projects. Likewise, demonstration of specific techniques in aquaculture such as induced spawning through hormone injection is organized by the Extension Officers.

For the demonstration of newly developed aquaculture technologies, the government agencies concerned usually utilize private farms, on condition that such farms are opened to the interested public.

d. Trainings and visits

Trainings and visits are employed in a modified manner. It is locally called cooperator approach whereby the selected clients who are willing to adopt a new technology and also willing to teach other farmers and provide access to their data are given intensive training and provided regular visits by the extension worker. Nearby fishfarmers who wish to adopt the tested technology of the cooperator are free to visit the farm of the cooperator and observe the techniques and practices used.

e. Mass media

Publications, news releases, radio and television are also used to disseminate information and transfer simple technologies. The BFAR and other concerned agencies usually put out appropriate hand-outs on various aquaculture subjects.

f. Field trips, field tours and workshops

These are usually used to supplement lectures and demonstrations during trainings. These are specially used when the training deals with a specific subject such as fishpen culture of milkfish, when tours to the culture sites are made.

g. Extension schools and farmers training centers

The Department of Agriculture usually provides venues or facilities for the conduct of agriculture training and extension in agriculture in established agricultural centers. In these existing centers, some of the facilities are also used for aquaculture extension training courses.

In the 60s and 70s there was a proliferation of fisheries schools in the country. Because of their large numbers (approaching 100 in total), they were very inadequately equipped and the training they rendered was very inadequate. To solve this problem the government abolished a large number of these schools and left only a few of the selected ones with good quality instructors and with fine facilities and were placed under the Department of Education, Culture and Sports (DECS).

To provide for the practical training needs for fishermen and fishfarmers, four Regional Institutes for Fisheries Training (RIFT) were established. For hands-on practical training of fishermen, four Regional Fishermen's Training Centers (RFTC) were established in strategic areas of the country. These centers continue to function at present although their activities are dependent on availability of funds.

3.4 Transfer of Culture Technologies

The transfer of culture technologies through the above mentioned extension methods are usually done upon request of clients or through selected cooperators. This strategy was adopted due to lack of adequate manpower to cover all the fishfarmers.

3.4.1 Description and listings of technology packages (Aypa, 1993)

Following are some of the aquaculture technologies that are presently being transferred to the aquaculture clients:

a. Genetically improved farm tilapia (GIFT)

Since 1976, tilapia has become the most important species cultured in freshwater fishponds. Although some species of carps (cyprinids) have been introduced earlier, there is lack of market demand for this group of cultured species. However, due to lack of knowledge of

hatchery operators and farmers on broodstock development, the quality of stock of farmed tilapia has continued to deteriorate.

In response to this problem, the Bureau of Fisheries and Aquatic Resources in collaboration with the International Center for Living Aquatic Resources Management (ICLARM) and the Central Luzon State University (CLSU) has developed a new strain of tilapia which is a product of cross-breeding of four strains of tilapia from Kenya, Senegal, Egypt and Ghana with the domesticated four Philippine *Nile tilapia* strains from Singapore, Thailand, Taiwan and Israel. The product resulting from the 36 successive cross-breeding is now being introduced to the freshwater fishfarmers.

b. Sex-reversed tilapia

The technology of sex reversal has long been developed but adoption is rather slow. Tilapia fry treated with methyl testosterone are held in nets suspended in ponds instead of in indoor tanks so that the farmers can easily adopt the method.

c. Improvement of tilapia culture techniques

The traditional stocking density of tilapia is 10 000 fingerlings/ha. Semi-intensive culture using 30 000 to 50 000 fingerlings/ha is now being promoted. Commercial pellets are given as supplemental feeds in addition to pond fertilization.

d. Polyculture of carp with tilapia

The techniques of polyculture of carp and tilapia have been transferred to the fishfarmers and are now successfully practised. This will promote the wider use of carps in pond culture.

e. Semi-intensive milkfish culture

The technology of semi-intensive milkfish culture is now widely adopted by the fishfarmers. With supplemental feeding, higher stocking density of 9 000 to 10 000 fingerlings/ha/crop are being used instead of the usual 3 000/ha/crop. Production per hectare has increased from 500-1000 kg/ha/yr. to 2 000-4 000 kg/ha/yr. Prospect of further increase is anticipated.

f. Culture management of milkfish using the modular method

By redesigning the ponds used for the culture of milkfish, multiple stocking can be achieved. Through this method multiple harvests of as much as six times or more during the year from the same pond can also be accomplished instead of the usual two orthree harvests. Production has also increased from the usual one or two mt per year to four to six mt per year. As this technology requires close management of the ponds and their stock, the practice is still limited to the more progressive milkfish farm operators of the country.

g. Semi-intensive and intensive shrimp culture

Extensive method of shrimp culture is predominantly practised by traditional fishfarmers. However, because of the increasing demand for shrimp not only in the local market but also for export the semi-intensive and intensive methods were promoted and were adopted by the fishfarmers with success. Production increased from 500 kg/ha/year to more than 3 000 kg/ha/year. However, the intensive system of shrimp culture is now being discouraged due to its adverse environmental effects while the semi-intensive and improved extensive methods are being promoted.

h. Seafarming/mariculture

The seafarming of shellfishes, seaweeds, finfishes and crustaceans is a growing industry in the country.

Oyster and mussel culture is already an established industry. The methods used are stake, hanging and tray; sometimes with modifications to suit the environment.

Seaweed culture is one of the important seafarming industries in terms of export. Species of *Eucheuma* are the most widely cultured species. Also cultured are species of *Gracilaria* and *Caulerpa*.

Finfish culture in marine waters is still in its infancy stage. Among the species that are now being cultured are groupers, siganids, giant perch and to some extent, the snappers. Culture can be done in ponds, netcages or pens.

For crustaceans, crab culture and crab fattening for the mangrove or mud crab is growing in importance because of the high demand and good prices of this commodity in the local as well as in the foreign market. At present, juveniles and young crabs can be grown in prepared cages usually made of bamboo or wood. If properly fed using trash fish, they grow rapidly and can be harvested in a few months. Supply of seed for culture is still adequate, but is expected to be scarce in the near future.

3.4.2 Transfer of technologies to fishfarmers by extension services and record keeping

The transfer of the above technologies to the fishfarmers as mentioned above has undergone changes not only in terms of extension service organization and structure but also in administration and supervision of the extension programmes/personnel brought about by the series of government reorganizations.

However, the extension methods employed are almost the same. Individual, group, mass media, training and visit, and demonstration are among the most widely used and accepted extension methods.

As far as record keeping is concerned, only records for those who are targetted or are identified as cooperators are kept by the extension workers. For those who are not regularly served or those who request for a one shot technical assistance, the activities are just reported but no individual data are kept.

3.5 Input Supplies, Equipment and Subsidies

Most of the farm inputs are locally available. Feed and feed ingredients, fertilizers and pesticides although partly imported can be purchased from local dealers.

The supply of stocking material or seed are cheap when available. The price of seed increases when there are critical shortages. New types of facilities or equipments such as pumps and paddlewheel aerators were introduced when new and intensified culture systems were adopted. These have to be acquired from outside sources.

Except in very special cases no subsidies are offered to the aquaculture industry. This is done during the occurrence of calamities such as severe typhoons, floods, volcano eruptions or earthquakes, wherein stocking material (fry/fingerlings) are supplied or soft loans are given to aquaculture projects victimized by such calamities.

3.5.1 Seed Supply

Supply of fish seed particularly those that are produced in hatcheries like tilapia and carp are not a problem. However, for those that are gathered from the wild like milkfish fry and those of groupers, siganids, giant perch and to some extent shrimps, there are certain periods of the year when there is shortage of supply for fry of these species.

3.5.2 Subsidies and/or credit facilities

The government do not offer subsidies for farm inputs. However, credit facilities are available. Under the FSP, the amount of PPs1.555 billion is budgeted for credit and the government approved PPs30 million as additional credit seed fund for 1993 for aquaculture, bringing the total seed fund allocation for this subsector to PPs650 M.

To further address the credit requirements of the aquaculture subsector, the DA also entered into Memorandum of Agreements with the Development Bank of the Philippines (DBP) and the Quedan and Rural Credit Guarantee Corporation (QUEDANCOR) for their participation in implementing the FSP Credit Component. To date, the seed fund has totalled PPs350 M with the Land Bank of the Philippines (LBP) allocating PPs290 M; the DBP PPs30 M and the Guarantee Fund for Small and Medium Enterprises (GFSME) PPs30M. In some cases high interest rates (20 percent or higher) and the requirements of prime collateral are hindering the process of utilization of available credits. The industry can readily use available credit at 12 percent or lower interest rates and under liberal security terms.

3.6 Control Mechanisms

The aquaculture extension services under the FSP and the NFOP are monitored regularly as embodied in these programmes.

3.6.1 Monitoring procedures at all levels of management

The FSP project monitoring and evaluation framework involves two levels. The first level is the progress monitoring and evaluation level which involves the monitoring of current operations on a regular recurring basis of the various components and activities using pre-designed monitoring reports. This is to ensure that implementation progress are proceeding in the desired direction and in accordance with the prescribed standards of cost, time, quantity and quality. It also allows for the various management levels to introduce the remedial measures when necessary. The progress evaluation conducted periodically, is designed to enable the management to make strategic decisions regarding the effects of procedures, standards, and policies on the achievement of target outputs.

The second level of the framework is the project benefit monitoring and evaluation (PBME) which essentially involves the verification and measurement of the effects that result from the outputs of the various components and activities of the programme. The information generated from this level is needed to make decisions on whether or not to modify the design of the FSP or the individual components and activities to ensure efficient coverage of their respective targets, as well as to whether or not to amend the methodology on development approaches to make it consistent with the programme design.

To facilitate the preparation of monitoring or progress reports by all the implementing agencies, input forms have been prepared for both monthly and quarterly reports. The forms are essentially the same for all agencies although there are additional forms for the Regional Offices and BFAR. This is due to the structural set up in the DA regional offices and the extensive involvement in several components and activities and the working arrangements in the case of BFAR. Likewise separate forms have been designed to monitor all training activities conducted.

Among the most important considerations in monitoring implementation process is the formulation of Work and Financial Plans based on predetermined targets and outputs against which performance could be measured and evaluated. The detailed operating procedures specific to each agency are given below.

a. Regional Offices

The primary generators of reports are the Municipal Agricultural Officers (MAO)/Agricultural Production Technicians (APT) who prepare monthly reports and submit to the Provincial Agricultural Officer (PAO).

The PAO through the Provincial Fisheries Management Units (PFMUs), integrates the monthly municipal reports into provincial monthly reports which are submitted to the Special Assistant for Fisheries Development (SAFD) with copies furnished to Program Management Office (PMO).

The SAFD prepares a summary of the major accomplishments, problems encountered and remedial actions taken or planned, with comments/recommendations.

In addition to the monthly reports, quarterly reports are also prepared and submitted to PMO. The quarterly reports are essentially a summary of major outputs and accomplishments achieved during the quarter which are compared with the quarterly targets.

b. Bureau of Fisheries and Aquatic Resources (BFAR)

BFAR coordinates and/or implements the components and activities under its overall responsibilities through several technical working groups (TWGs), each headed by designated team leader or chairman. The TWGs, therefore, become the primary generators of the monthly progress reports which are submitted to the duly-designated Program Implementing Officer (PIO) for BFAR with copies to the PMO.

The TWGs' progress reports are summarized by the BFAR PIO and submitted to PMO through the BFAR Director. In addition to the monthly reports, quarterly reports are also submitted to PMO.

For the other implementing agencies [e.g., Agricultural Credit and Policy Council (ACPC), Department of Environment and Natural Resources (DENR), Bureau of Agricultural Research (BAR), Bureau of Agricultural Statistics (BAS), and Philippine Fisheries Development Authority (PFDA)], monthly and quarterly reports are also submitted.

3.6.2 Evaluation procedures and mechanism

Based on the monitoring reports, particularly the quarterly reports, a quarterly evaluation is made by comparing the progress of accomplishments with the targets set forth in the annual work and financial plan. This becomes the basis for determining the implementation performance and assists in evaluating the progress of activities.

3.6.3 Management information system (MIS) (Anonymous, 1993a)

A National Fisheries Information System (NFIS) is now being established under the FSP. The NFIS will provide solid technical, ecological and economic database support for policy, investment and resource management decisions for the sector. The NFIS shall commence with the following activities.

a. Comprehensive resource and ecological assessment in the 12 priority bays.
b. Inventory and assessment of inland fisheries and aquaculture projects in the eight

priority regions (Regions 1, 3, 4, 5, 6, 7, 9, and ARM[3]).

c. Stock assessment and exploratory fishing for tuna in selected offshore waters.

3.7 Extension and Research Linkage

Extension's inputs are the researchers'output, hence for the extension service to be effective a strong linkage is imperative.

3.7.1 Relationship among research institutes, extension officers and producers

In general, the relationship among the research institutes, the producers and the extension officers is fairly harmonious. However, for those institutions that are basically involved in fisheries education, research and extension, the linkage is strong but in some cases to further strengthening the linkage, Memorandum of Agreements or Work Contracts are executed in order to formalize the working relationships.

As regards the producers, those who are already adopting high level technologies are more independent because they do their own research. Nevertheless, they also share their technologies with the small-scale producers through conventions, seminars and workshops.

In the case of small scale producers and beginners, they usually request for technical assistance from the government extension workers. Such assistance are given through field visits, lecture/demonstrations and training courses/seminars.

To further strengthen the linkage among the researchers, the extension workers and the producers, a Fisheries Research and Extension Task Force Advisory Committee (FRETFAC) has been formed under the FSP's Research and Extension Component (REC). The Task Force is composed of representatives from the national fisheries agencies, research institutions, state universities and colleges, and the aquaculture and marine fisheries sectors.

3.8 Non-Governmental Organizations (NGOs) in Extension

NGOs are considered partners of government in development. This is well recognized under the FSP and NFOP, hence they are involved in most of the extension activities under the Program but most specifically in community organizing and in some cases in the conduct of technical and socio-economic studies.

There are several aquaculture-oriented NGOs (66 are listed) existing in the country and they are fairly active.

NGOs also organize conventions, seminars and workshops which aim to disseminate newly developed aquaculture technologies.

4. PRODUCTION, MARKETING AND ECONOMICS

4.1 Production

4.1.1 Total aquaculture production in recent years

During the 50s, 60s and most of the 70s the aquaculture industry was mainly confined to brackishwater fishponds for raising milkfish. But during the latter part of the 70s and through the 80s up to the present time the aquaculture industry rapidly expanded and became more diversified

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[3] Autonomous Region in Mindanao (ARM) is an administrative group composed of Maguindanao, Lanao del Sur, Sulu and Tawi-Tawi provinces.

so that the total aquaculture production rose very rapidly (Table 3). Production statistics reveal that in the earlier period (1947-1978, Table 3) aquaculture production was only 8 to 14 percent of the country's total fisheries production. In 1979 this sector rose to 15 percent and this rapidly increased to the extent that in 1992 aquaculture contributed 28 percent of the total fisheries production (Tables 3 and 4).

In terms of value, the aquaculture production in 1983 was only 25 % of the total value of fisheries production in that year. The relative percentage of the value of aquaculture to the total gradually rose so that in 1992, the percentage of aquaculture production to total fisheries production attained 40 percent although this was only 28 percent in volume (Table 4).

4.1.2 Production per unit area (Table 9)

Productivity per unit area in aquaculture farms have increased during the last decade primarily due to improved technology and proper dissemination through training and extension programmes. In brackishwater ponds with a total area of 222 906 ha, overall average production per ha was 1.41 mt. The two major species farmed are milkfish and shrimps. In 1989, milkfish production/hectare/year were 1.9 and 1.1 mt using the modular and straight-run methods, respectively (Agbayani et al, 1989). Shrimp production in 1992 as reported in the Philippine Prawn Policy Study by Auburn University were 0.6 mt for extensive, 4.16 mt for semi-intensive and 8.0 mt for intensive culture systems.

In 1992, in freshwater aquaculture, productivity per hectare of 53.64 mt was highest using fishcage culture method. This is due to the intensive stocking density and supplementary feeding used by fishfarmers. In freshwater ponds and pens, productivity per hectare was only 2.82 and 2.32 mt per hectare, respectively.

There is a very bright future for mariculture or seafarming of seaweeds considering the country's coastline of 34 600 km and a coastal area of 26 million hectares. The current production of seaweeds is about 291 000 mt or 40 mt per hectare. In the case of oyster and mussel farming, production per hectare averaged about 29 mt. Oyster and mussel farmers are mainly small-scale fishermen whose income from fishing are supplemented by farming oysters and mussels.

4.1.3 Production trends, short- and long-term

Although the annual growth rate of aquaculture production was high at 11.90 percent during the period 1980-1992, it decreased to 8.05 percent during the last half of the past decade. Among the species cultured in the country, seaweeds production is expected to increase substantially both in the short- and long-term periods due to the vast coastal area which has remained untapped. The low technology, low capitalization and expanding export market for seaweed has made it a viable alternative livelihood for coastal fishermen. The presence of big processors/exporters in the country is an advantage to the seaweed farmers in marketing their products at relatively high prices.

Milkfish, as a traditional aquaculture product, will always be a favourite among Filipinos. Milkfish prices are stable in the market which keeps the growers secure in their production. The problem of milkfish farmers, however, is the supply of fry which has become scarcer. Optimum stocking of milkfish ponds cannot be attained because of this situation. The SEAFDEC technology on milkfish breeding and hatchery operation is slowly being adopted by some private hatchery operators in Panay island. The National Milkfish Breeding Program of the Department of Agriculture and the Bureau of Fisheries and Aquatic Resources has made milkfish broodstock and fry available to private milkfish hatchery/nursery operators. Export of milkfish to the Filipino communities residing abroad primarily in the United States have convinced some growers to extend their culture period to attain bigger sizes which are preferred. Most milkfish growers, however, prefer to sell locally because of the stable domestic prices.

Tilapia production in freshwater sites will continue to increase in view of the taste preference of the Metro Manila consumers. The hatchery and the sex-reserval technologies that have been successfully disseminated to tilapia growers have contributed significantly in the increase in production in fishcages and freshwater ponds. Too much intensification and improper feeding regimes, however, have resulted in pollution of lakes such as the Sampaloc Lake and adjacent small lakes in San Pablo City, Laguna province, Luzon. Technology transfer through training and extension work will help tilapia farmers to manage the freshwater resources in a sustainable manner.

Shrimp production will increase for as long as the export prices are high. The biggest problem confronting the shrimp farmers is the deterioration of ponds due to the uncontrolled feeding practices which have resulted in pollution of ponds and waterways. Occurrence of diseases, if not prevented or minimized, will continue to result in low production in intensive farms. Environment-friendly culture methods such as semi-intensive with crop rotation culture systems will reduce the occurrence of diseases and will ensure sustainable production. Technology transfer through training and extension work will help shrimp farmers to attain production levels that will provide good returns on their investments.

Oyster and mussel farming is a viable alternative livelihood among coastal fishermen (Samonte et al, 1993). Environmental deterioration such as the occurrence of red tide has adversely affected the farmers in terms of production and marketing.

4.2 Marketing

4.2.1 How and where

The geographical distance of the market from the fish farm and the unreliable transportation system have placed the fish farmers at the losing end of price bargaining. Farmers harvest, chill and transport their fish to the fish market and transact the sale through a broker. The broker negotiates with the different buyers who are either wholesalers, processors, restaurant owners, or retailers. The broker gets a fee of about five percent from the sale of the fish. Sales could either be on consignment or cash basis depending upon the supply and demand situation. Consumers can easily shift to other food items when fish prices are high.

4.2.2 Marketing channels

Marketing channels or channels of distribution are the pathways taken by the commodities as these flow from point of production to point of immediate and final use. This marketing function is being carried out by a series of intermediaries or marketing agencies called brokers, wholesalers and retailers. Other traders/handlers involved in the marketing channels are processors and exporters (Figures 11 and 12).

Figure 11 shows the marketing channel for fish originating from municipal fish landing centers where the fishermen or fish farmers have direct contact with practically all the buyers (wholesalers, retailers, processors, exporters and consumers). However, the major outlet of the producers are the wholesalers. They are more popular to the small-scale fishermen because they extend credit in the form of cash or supplies; no interest is charged but the fishermen/fishfarmers are obliged to sell their product to the wholesaler creditors. The price of fish is usually dictated by the wholesaler. Most of the retailers are wives of the producers who sell the product in the public market or in adjacent towns. The processors are usually small-scale fish driers while the exporters are represented by their agents who establish buying stations for exportable species like tuna and shrimps and likewise groupers, snappers, etc.

Figure 12 shows the marketing channel for fish originating from urban centers such as fish ports/terminal markets or commercial fish landing centers. In this scheme of distribution, the brokers take immediate possession of the fish for distribution to wholesalers, retailers, processors

and exporters all of whom also receive direct supplies of selected species (e.g. tuna) from the producers. The wholesalers generally transact the product in bulk to the retailers and also supply the processors and exporters. The retailers are the ultimate link to the consumers.

The roles of the different links in the two types of marketing channels are further explained in the following subsections.

Brokers. - Producers who do not wish to take the responsibility for selling their products hire the services of fish brokers. They are also called agents who act as intermediary between fishing boat or fishfarm operators and wholesalers. For compensation, they receive a fee or commission of five to seven percent on the total sale proceeds. They perform a very specialized service because they are easily accessible, are in close contact with many dealers and are always up-to-date on prices and other market information. However, the brokers shoulder the risk of delayed or non-payment from their clients who are usually the wholesalers.

Wholesalers. - These are fish traders who acquire fish from producers and/or brokers and sell to other buyers such as the processors, other wholesalers and the retailers (but usually not to the ultimate consumers). The wholesalers have an important function in the efficient disposal of fish inasmuch as they buy in big quantities. They usually provide themselves with the necessary transport to distribute the product to other buyers. They are being trusted by producers and brokers because they purchase in big volumes on credit but they usually pay diligently when payments are due.

Retailers. - The principal function of the retailers is to set up an establishment usually a stall at the public market where the fish are offered for sale to the ultimate consumers. In the absence of this physical facility retailing can be done in other sites (seashore, fishfarm, private stores, supermarkets, etc.).

Processors. - They buy fish in bulk for processing into salted dried, smoked fish, fish meal, fish sauce, fish paste, etc. Also included are canners who buy fish with high degree of freshness for canning (e.g., tuna, mackerel, etc.).

Exporters. - They buy fish for export to foreign markets. They usually have rigid requirements with regards to quality control.

The number of intermediaries in the marketing channels depends on the size of the fish market. In urban areas, the fish farmer transacts business through a broker who in turn will negotiate with different buyers. Wholesalers or assemblers buy in large volumes for reselling to retailers, processors, and other institutional buyers. The retailers or stall owners sell to the buying public at prices which can reach about 50 percent higher than the selling price of the fish farmer. Each intermediary contributes to the increase in price in the retail end of the market chain.

The middlemen are always maligned as price manipulators to the detriment of end consumer. The middlemen, however, play important roles aside from fish distribution. They provide credit to fish farmers, storage and transportation facilities to bridge the gap between production and consumption, and provide price information. Such functions cannot be effectively performed by the fishfarmers unless they form themselves into cooperatives. Management of cooperatives will require the hiring of professional managers since most of the fishfarmers have their own business to attend to. Moreover, organizing fishfarmers into cooperatives have failed in the past due to the lack of interest of members in matters affecting the cooperative. This is changing, however, and the number of successful aquaculture cooperatives is increasing.

4.2.3 Local and distant markets

Local fish markets are those located within the municipality or province where the fish farmer operates. Distant markets are those outside of the province where transport of the fish will

take longer and proper chilling will be required to avoid spoilage. Since most aquaculture farms are located far from the consuming public, transportation and cold storage facilities are important to maintain the quality of the fish and attract high prices. In Luzon, Metro Manila is the biggest market for fish products. In the Visayas, which is a major fish producing region, per capita consumption of fish is also highest.

4.2.4 Transportation to market

For local markets, fish are transported by pump boats or land vehicles. On the other hand, transportation to distant markets are either by land vehicles, boat or aircraft. The returns to the fishfarmer to some extent, depends on the cost of moving the fish products from the farm to the market. Milkfish from Iloilo, Panay island in the middle Philippines, for example, are transported by boat to Manila. The high cost of transport is compounded by the lack of cold storage facilities which forces the fishfarmer to ship out their products to distant markets. High-value aquaculture products such as live groupers are airfreighted to Manila at high cost.

4.2.5 Export market

Shrimps and seaweeds are the main aquaculture export products of the Philippines. Shrimp exports in 1992 was estimated to be 23 623 mt valued at US$211.45 million. Seaweeds export in the same year was 22 756 mt valued at US$18.95 million. Export of shrimp to Japan accounted for 75.76 percent of total shrimp export, followed by the United States with 16.21 percent, and the rest to other countries such as Korea and some European countries.

Unlike shrimp, seaweed exports are distributed to many developed European countries such as United Kingdom, Denmark and France. Japan is also an importer of seaweeds. The wide industrial uses of processed seaweeds such as carageenophytes make investment in seaweeds (especially *Kappaphycus alvarezii (Eucheuma)* and *Gracilaria)* profitable for coastal fishermen.

4.3 Economics

Economic analysis of selected aquaculture species such as the jumbo tiger shrimp (*Penaeus monodon*), milkfish, seaweeds, oysters and mussels are herein discussed.

4.3.1 Shrimp (Table 10)

The three culture practices in shrimp production are extensive, semi-intensive, and intensive (Table 10). Culture periods for all types of culture systems range from 138 to 160 days. Based on the 1992 Philippine Prawn Policy Study done by Auburn University, Auburn, Alabama, U.S.A., average operating cost per hectare per crop were PPs29 450 for extensive, PPs388 000 for semi-intensive, and PPs630 820 for intensive systems (Table 10). Net operating profit per hectare per crop were PPs29 510, PPs30 430, and PPs143 040 in the same order. The return on operating capital was highest in the extensive systems at 100 percent and lowest in the semi-intensive system at 7.84 percent. Intensive culture method registered a 22.68 percent return on operating cost.

The high return for extensive culture method was due to low cost of feed which were mainly "trash fish" and natural food available in the ponds. With a low stocking density, proper fertilization of ponds can supply additional natural feed for the shrimps. In the case of semi-intensive and intensive culture systems, commercial feed with an average cost of PPs30.00/kg are fed to the shrimps. Cost of feed accounted for 56-66 percent of total operating cost in semi-intensive and intensive culture methods.

4.3.2 Milkfish (Table 11)

Milkfish production have increased during the last decade from an average of about 0.52 mt/hectare to about 1.1-1.9 mt/hectare (Agbayani et al, 1989) due to increase in use of fertilizers and use of the modular method of management. The modular method increased the number of crops per year from three to six. Comparative production were 1.884 mt for modular and 1.1 mt for straight-run culture system. Operating costs per hectare per year were PPs27 690 and PPs15 352 using modular and straight-run methods, respectively. In terms of profit, the modular method was higher with PPs11 664 net income and return on investment of 61 % compared with straight-run systems with PPs7 538 and 56 %, respectively.

4.3.3 Oysters and mussels

In oyster and mussel farming (Table 12), net income per farm per crop was PPs2 947 for mussel farming and PPs956 for oyster farming (Samonte et al, 1993). Culture period for both systems was about 6-8 months from spat collection to harvest. Training and extension activities would help small-scale farmers to increase their productivity through the implementation of improved methods of spat collection, site selection, culture, harvesting and marketing.

4.3.4 Seaweeds (Table 13)

Seaweed farming is an appropriate technology for adoption by coastal fishermen in view of its low technology, low capitalization and high export demand. Depending on the site, seaweed farmers can have multiple crops per year. Two farming systems adopted by farmers are the bottom line and the raft monoline. In 1990, annual production cost (Table 14) were PPs19 471 for bottom line and PPs42 457 for raft monoline methods (Samonte et al, 1993). The corresponding annual net farm incomes for two crops were PPs66 574 and PPs52 732 in the same order. Even with a half hectare family-size farm, the additional income to the coastal fisherman's household will be very substantial. Training and extension activities are presently being undertaken by both government and non-government organizations in promoting seaweed culture among coastal fishermen.

5. SOCIO-ECONOMIC BENEFITS

5.1 Employment

5.1.1 Employment and opportunities

Employment in the aquaculture sector is estimated to be 258 480 persons in 1992 (BFAR Fishery Profile, 1993). This estimate was based on a one-person per-hectare based on total area devoted to brackishwater and freshwater ponds. This estimate is very low since one person cannot effectively operate one-hectare pond. In the shrimp industry, manpower requirement is estimated to be 1.5 persons per hectare. The hatchery sector employs 2-5 persons per hatchery or about 3 000 in the whole country. Additional income is also earned by spawner collectors who are basically small-scale fishermen. Employment generated by exporters/processors, feed millers, middlemen, suppliers of aquaculture inputs was not considered in the estimate. Moreover, researchers, academicians, extension workers and consultants were not also included in the estimate.

Part-time employment especially during pond repairs and preparation and harvesting can be more than the regular workers in the various aquaculture systems.

5.1.2 Prospect for creating jobs

In view of the high capital requirement in inland aquaculture (brackishwater and freshwater), there are better prospects of employment generation in mariculture or seafarming. Seaweed and fish cage/pen culture in coastal areas can offer viable alternative livelihood among coastal fishermen. Employment estimate in coastal fisheries was about 675 677 (1992) and is still growing.

The present thrust of the ADB-assisted Fishery Sector Program of the Department of Agriculture in community-based coastal resource management requires the strong support of the non-government organizations active in fishing communities. The dual objectives of conserving the coastal resources and increasing the income of fisherfolks through the adoption of environment-friendly mariculture of seaweeds and finfishes can be met by effective training and extension programmes. Emphasis on training and extension programmes should be on environmental awareness and management, value orientation and skills development.

5.2 Additional Family Income

Mariculture of oysters, mussels and seaweeds offer the best opportunity for coastal fisherfolks to increase income as an additional livelihood. Studies on economics of oyster and mussel farming show that the net profit of PPs956-3 000 per hectare per crop can easily be made. In seaweed farming for carrageenophytes, the estimated annual income from two crops per year is PPs53 000-66 500 as experienced by Panay small-scale farmers (Samonte et al, 1993).

Additional income for fishermen can also come from the supply of shrimp spawners to hatchery operators priced at PPs800-1 000 per piece depending on the stage of maturity and distance to hatchery site.

Part-time work for fishermen in ponds during pond repair and preparation and harvesting will mean additional income. This type of work is seasonal and requires skill.

Women in fishing communities can engage in simple fish processing and marketing aside from their regular household chores. In the aquaculture industry the services of women are predominant in the operation of shrimp and fish hatcheries and in the processing and trade of aquaculture products.

5.3 Nutritional Benefits

Fish is an important staple food for Filipinos. Consumption of fish per capita is one of the highest in the world, estimated at 35-40 kg per year. Fish provides the Filipinos 70 percent of animal protein and 30 percent of total protein. It is second to rice and other cereals, which provides 55 percent of protein intake. About 80 percent of total fish production in the country is consumed locally and the rest are exported.

5.4 Progress, Constraints and Potentials

5.4.1 Progress made by aquaculture extension services

Training and extension are the important strategies of the development policies and plans of the fisheries sector. One of the developmental functions of BFAR is to provide technical assistance, educational and training programmes for the enhancement of the fisheries industry by continuing to maintain and operate the five National Fisheries Research Centers in Muñoz, Tanay, Pagbilao, Butong and Cavite. SEAFDEC Aquaculture Department undertakes yearly training programmes in the different aspects of aquaculture such as fish health, fish nutrition, breeding and hatchery management, culture methods and aquaculture management. It also undertakes outreach programmes in the different parts of the country where technology updates are needed. The

Technology and Livelihood Resource Center (TLRC), a public training institution for small investors, offers to interested parties training on aquaculture techniques which can be adopted in small- and medium-scale operations.

Aquaculture organizations and cooperatives sponsor seminars and conferences on various topics of interest to the aqua-culturists. Regional development councils also sponsor seminars and conferences on aquaculture to update aquaculture practitioners on the latest technologies. Researchers and other experts are invited to talk on important topics such as diseases, nutrition, environmental concerns and government policies.

5.4.2 Problems and constraints

Problems encountered in the aquaculture sector are related to: (1) appropriate technology generation and dissemination; (2) environmental factors; (3) market expansion; (4) credit and financing; and (5) government support and policies. In pond aquaculture (freshwater and brackishwater), technology development and dissemination must be pursued. Fish diseases, for example, caused mainly by environmental deterioration, have resulted in losses to investors. Improper application of technology in feeding schemes especially for semi- and intensive culture methods have caused the pollution of freshwater and brackishwater bodies in Laguna Lake in Luzon and Western Visayas in middle Philippines. Overpumping of freshwater for intensive shrimp farming resulted in seawater intrusion which can be irreversible (Primavera, 1991).

Technology dissemination through training and extension activities should be actively undertaken both by government and private investors to inform private aquaculturists of the advantages and disadvantages of the different aquaculture systems especially in intensive methods.

Market expansion of exportable species is impeded primarily by the lack of market information in non-traditional export markets such as Europe and developed Southeast Asian countries (South Korea, Hong Kong, Singapore). Export market promotions should be strongly pursued both by government and private sectors. Product development and packaging can increase the market value of exportable products especially in developed countries. Aquaculture technology for high-value species such as groupers and snappers should be hastened to produce products for export.

Loans to aquaculture ventures are treated as a commercial loan with interest rates higher than competing countries such as Indonesia, Thailand and Taiwan (Province of China). Moreover, banks require prime real estates as collaterals making it difficult for small- and medium-scale fish farmers to avail of credit from the banking system.

The activities of the Fishery Sector Program (FSP) under DA should be closely coordinated with the activities of the other concerned government agencies such as the Department of Environment and Natural Resources (DENR), Department of Science and Technology (DOST) and Department of Trade and Industry (DTI). With the enactment of the Local Government Code of 1991, local government units (LGUs) have become potent partners in aquaculture development in the countryside.

The socially-oriented Comprehensive Agrarian Reform Law (CARL) was passed and approved and has become operational. The mandate under this Law to subdivide existing fishfarms into small parcels not exceeding five hectares will adversely affect the aquaculture industry. The tenants or occupant fishfarmers are unprepared and lack operating capital to manage the farms so that application of the Law at this time can cause serious setback to the industry. Amendment to this Law for exempting fishfarms has now been presented to the Congress and its approval is awaited. Pending its approval, the fishfarm owners seems to be hesitant to invest for the management and improvement of their farms.

5.4.3 Potentials of expanded aquaculture

Mariculture or seafarming has the greatest potentials for further development. With a coastal area of 26.6 million hectares largely devoted to small-scale fishing, mariculture of selected species such as seaweeds, finfishes, molluscs and crustaceans can offer a good opportunity for increasing production and income of coastal fisherfolks. Development strategy should be on community-based approach to coastal resource management with a strong support in terms of training and extension by government and non-government organizations (NGOs). Research activities on biological resource assessment and more importantly on the socio-economic issues in coastal fishing communities will provide policy-makers and implementors with solid baseline data information.

Expansion in inland aquaculture, particularly in brackishwater may result in further deterioration of the resource base with improper use of intensive culture techniques. High returns on investment in the short-term cannot compensate the irreversible destruction of inland resources. Some degree of expansion can still be possible in freshwater areas especially by utilizing water bodies previously not used or underutilized for this purpose. Culture of species with good market demand (e.g. tilapia and prawn) and use of recently developed technologies like fishcages, fishpens and integrated aquaculture systems can further diversify the industry.

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Table 1. The Philippines as fisheries producer

Year	Volume Philippines (mt)	Volume World (mt)	Percent Philippine production on World production	Rank among World producers
1972	1 220 200	64 239 800	1.9	13
1973	1 303 500	65 095 900	2.0	12
1974	1 370 958	65 841 800	2.1	12
1975	1 442 981	65 572 600	2.2	12
1976	1 393 424	69 106 900	2.0	13
1977	1 508 705	68 006 100	2.2	12
1978	1 494 580	69 954 700	2.1	14
1979	1 475 196	70 860 400	2.1	14
1980	1 556 602	71 808 300	2.2	13
1981	1 686 636	76 464 200	2.2	13
1982	1 786 790	78 767 700	2.3	13
1983	1 976 141	77 487 400	2.6	11
1984	1 933 706	83 910 500	2.3	12
1985	1 864 990	86 323 600	2.2	12
1986	1 916 347	92 803 500	2.1	11
1987	1 988 718	94 378 600	2.1	11
1988	2 010 363	99 016 100	2.0	11
1989	2 098 787	100 208 300	2.1	11
1990	2 208 823	97 433 500	2.3	11
1991	2 311 797	96 925 900	2.4	11

Source: FAO Yearbook, Fishery statistics, 1978, 1988, 1993

Table 2. The Philippines as aquaculture producer

Year	Volume Philippines (mt)	Volume World (mt)	Percent Philippine production on World production	Rank as aquaculture producer
1984	477 887	6 660 475	7.2	6
1985	495 634	7 726 028	6.4	6
1986	470 924	8 802 757	5.3	6
1987	560 970	10 144 694	5.2	5
1988	599 464	11 199 378	5.4	5
1989	629 325	11 433 457	5.5	5
1990	672 266	12 101 780	5.6	5
1991	692 477	12 675 087	5.5	5

Source: FAO, 1992. Aquaculture production, 1984-1990. FAO Fish. Circ. No. 815, Rev. 4; 1993, FAO Fish. Circ. No. 815, Rev. 5

Table 3. Volume of fish production in the Philippines, by sector, (1947-1992)

Year	Capture fisheries (mt)	Aquaculture (mt)	Total (mt)	Percent aquaculture on total
1947*	230 661	20 789	251 450	08
1948	172 048	23 031	195 079	12
1949	213 495	24 508	238 003	10
1950	194 726	25 464	220 190	12
1951	266 420	29 669	296 089	10
1952	282 022	31 038	313 060	10
1953	272 154	33 472	305 626	11
1954	308 591	35 034	343 625	10
1955	326 193	36 733	362 926	10
1956	355 168	38 480	393 648	09
1957	347 756	39 414	387 170	09
1958	369 042	57 624	426 666	14
1959	378 391	58 090	436 481	13
1960	374 503	60 120	434 622	14
1961	394 075	60 825	454 899	13
1962	422 512	61 436	483 948	13
1963	485 310	62 044	547 350	11
1964	540 826	62 680	603 506	10
1965	604 004	63 198	667 202	09
1966	641 624	63 654	705 278	09
1967	682 151	63 912	746 063	09
1968	850 973	86 711	937 684	09
1969	846 219	94 573	940 792	10
1970	892 423	96 461	988 884	10
1971	925 180	97 915	1 023 095	10
1972	1 023 487	98 923	1 122 410	09
1973	1 105 537	99 600	1 204 837	08
1974	1 155 173	113 195	1 268 368	09
1975	1 230 342	106 461	1 336 803	08
1976	1 234 191	159 292	1 393 483	11
1977	1 345 265	163 590	1 508 855	11
1978	1 363 749	210 655	1 580 404	14
1979	1 340 105	241 198	1 581 303	15
1980	1 383 088	289 166	1 672 254	17
1981	1 433 396	339 501	1 772 897	19
1982	1 504 635	392 348	1 896 983	21
1983	1 665 157	445 073	2 110 230	21
1984	1 602 381	477 887	2 080 268	23
1985	1 557 369	494 742	2 052 111	24
1986	1 618 591	470 893	2 089 484	23
1987	1 652 070	560 970	2 213 040	25
1988	1 670 190	599 554	2 269 744	26
1989	1 741 764	629 345	2 371 109	27
1990	1 832 430	671 116	2 503 546	27
1991	1 906 580	692 410	2 598 981	27
1992	1 889 226	736 318	2 625 607	28

Source: Bureau of Fisheries and Aquatic Resources database (various years).
*Year when fisheries statistics started to be collected systematically.

Table 4. Volume and value of fish production, by sector, in recent years (1983-1992)

4a. Volume (mt)

Year	Capture Fisheries		Aquaculture	Total	Percent aquaculture on total
	Municipal	Commercial			
1983	1 145 841	519 316	445 073	2 110 230	21
1984	1 089 046	513 335	477 887	2 080 268	23
1985	1 045 382	511 987	494 742	2 052 111	24
1986	1 072 361	546 230	470 893	2 089 484	23
1987	1 060 878	591 192	560 970	2 213 040	25
1988	1 070 195	599 995	599 554	2 269 744	26
1989	1 104 626	637 138	629 345	2 371 109	27
1990	1 131 866	700 564	671 116	2 503 546	27
1991	1 146 765	759 815	692 401	2 598 981	27
1992	1 084 360	804 866	736 381	2 625 607	28

4b. Volume (Million PPs)

Year	Capture Fisheries		Aquaculture	Total	Percent aquaculture on total
	Municipal	Commercial			
1983	9 540	4 643	4 799	18 982	25
1984	11 863	6 521	7 266	25 650	28
1985	14 716	7 857	8 724	31 297	28
1986	17 215	9 248	10 832	37 331	29
1987	16 108	9 821	11 314	37 243	30
1988	16 633	10 272	15 213	42 118	36
1989	18 388	11 033	15 673	45 094	35
1990	19 300	12 411	20 467	52 178	39
1991	22 133	15 245	22 656	60 034	38
1992	22 656	16 801	25 986	65 443	40

Source: Bureau of Fisheries and Aquatic Resources. 1993. 1992 Philippine fisheries profile

Table 5. Aquaculture production, by system and environment, (1983-1992)

Volume: mt
Value: (Million PPs)

Year	Brackish-water fishpond	Fresh-water fishpond	Fishpen mainly in freshwater	Fishcages mainly in freshwater	Seafarming for molluscs	Seafarming for seaweeds
1983	183 773 (3 123)	12 052 (112)	82 564 (1 107)	4 664 (37)	29 816 (169)	132 204 (251)
1984	198 729 (5 117)	13 111 (167)	81 966 (1 357)	7 070 (86)	34 923 (257)	142 088 (281)
1985	198 546 (6 522)	15 862 (282)	51 979 (1 202)	7 441 (136)	37 948 (279)	182 946 (304)
1986	207 274 (8 692)	15 503 (365)	41 296 (1 035)	9 373 (223)	28 579 (193)	168 868 (334)
1987	234 584 (9 131)	30 165 (612)	35 588 (732)	17 789 (361)	22 005 (155)	220 839 (431)
1988	240 206 (12 755)	32 922 (748)	23 814 (574)	18 260 (417)	27 947 (214)	256 405 (505)
1989	253 580 (12 838)	34 238 (855)	24 102 (654)	19 502 (479)	29 222 (241)	268 701 (605)
1990	267 814 (16 762)	35 816 (1 333)	24 379 (685)	20 931 (570)	31 000 (320)	291 176 (796)
1991	291 275 (18 449)	37 974 (1 360)	25 931 (815)	23 939 (676)	29 499 (3 161)	283 783 (1 040)
1992	234 875 (19 296)	48 752 (2 229)	33 395 (1 324)	34 292 (1 161)	35 562 (449)	349 505 (1 527)

Source: Bureau of Agricultural Statistics, 1993. Fishery statistics, 1983-1992

Table 6. Production of major cultivated species in the Philippines (1983-1992)

Volume: mt
Value: (000 PPs)

Year	Milkfish	Tilapia	Tiger shrimp	Oysters	Mussels	Seaweeds
1983	155 995) (2 091 893)	11 315 (105 858)	9 287 (835 830)	11 310 (48 633)	18 506 (120 289)	132 204 (251 188)
1984	155 709 (2 578 541)	11 602 (146 104)	26 357 (2 244 035)	14 617 (95 010)	20 306 (162 448)	142 088 (281 334)
1985	155 344 (3 594 660)	13 874 (252 784)	26 537 (2 493 947)	15 268 (78 019)	22 680 (200 719)	182 946 (303 690)
1986	158 621 (4 265 319)	14 064 (336 692)	27 960 (3 777 300)	16 465 (85 618)	12 114 (107 210)	168 868 (334 359)
1987	179 791 (4 126 293)	26 751 (541 973)	32 380 (4 460 994)	10 361 (52 841)	11 644 (101 885)	220 839 (430 636)
1988	175 935 (4 702 741)	30 149 (690 714)	41 548 (7 437 508)	12 445 (74 670)	15 502 (139 518)	256 405 (505 118)
1989	181 197 (4 988 353)	30 900 (779 916)	43 539 (6 966 240)	12 819 (89 219)	16 403 (152 279)	268 710 (604 578)
1990	191 878 (6 566 424)	35 169 (1 316 502)	47 591 (9 278 889)	13 485 (126 212)	17 515 (194 113)	292 176 (796 077)
1991	213 674 (2 230 887)	37 358 (1 341 123)	45 740 (8 246 568)	12 154 (108 792)	17 345 (207 077)	283 783 (1 079 771)
1992	145 554 (5 775 514)	48 006 (2 192 302)	75 996 (12 472 439)	15 103 (170 802)	20 459 (278 247)	349 505 1 526 896)

Source: Bureau of Agricultural Statistics, 1993. Fisheries statistics, 1983-1992.

Table 7. Research and related activities of ICLARM, 1991

	Coastal area management	Capture fisheries management	Aquaculture
Bangladesh			●●□
Brunei Darussalam	●		
Chile		●⌂	
Cote d'lvoire			□
Ghana			●
India			⌂
Indonesia	●☺		
Malawi			●□⌂
Malaysia	●☺		
Philippines	●☺		●□
Sierra Leone		●	
Singapore	●□		
Solomon Islands		●☺	●●☺●
Sri Lanka	⌂		
Thailand	●☺		
Regional	●☺	☺	●●
Global	⌂	●●●☺	●☺

Key: ● Project; ☺ Network; ⌂ Advisory Services;
□ Workshop/conference/training organized by ICLARM.
Source: ICLARM. 1992. ICLARM Report 1991

Table 8. Total cost of fisheries management and development plan by component, 1993-1998 (in million PPs)

Component	Total	Share (%)
Aquaculture development	5 396	28.1
Marine fisheries management	5 547	28.9
Law enforcement	2 357	12.3
Infrastructure, post harvest, marketing	2 773	14.4
Other inputs:		
Credit	1 555	8.1
Information	270	1.4
Programme management	1 331	6.8
Total	19 209	100.00

Source: Anonymous. 1993. Medium Term Fisheries Management and Development Plan, (MTFMDP) 1993-1998
Note: Philippine pesos (PPs27.5 = U.S.$1 in April 1994)

Table 9. Aquaculture production per unit area of different culture systems*

	Production (mt)	Area (ha)	Production per hectare (mt)
Brackishwater ponds	314 343	222 907	1.41
Milkfish			
Modular system			1.9
Straight-run			1.1
Shrimp (P. monodon)			
Extensive			0.60
Semi-intensive			4.16
Intensive			8.00
Freshwater ponds	41 027	14 531	2.82
Fishpen	28 103	12 105	2.32
Fish cages	28 858	538	53.64
Mariculture	324 050		
Oysters and mussels	31 000	1 069	29
Seaweeds	291 000	7 275	40

*Based on various sources and actual survey made in 1992

Table 10. Cost and returns of different culture systems of shrimp (Penaeus monodon), 1992

	Extensive	Semi-intensive	Intensive
Revenues	58.96	418.43	773.86
Operating costs (PPs000/ha)			
Fry	6.61	47.6	51.61
Feeds	7.4	208.83	398.09
Pond preparation	0.98	19.65	10.89
Power	0.01	42.31	58.4
Fuel/oil/lube	0.27	3.91	7.78
Salaries & allowances	3.96	30.51	39.5
Repairs & maintenance	3.63	11.37	17.85
Others	5.2	7.04	15.83
Subtotal/ha/run	28.06	371.21	599.96
Interest on variable cost	1.4	16.79	30.87
Total variable cost	29.45	388	630.82
Income above variable cost	29.51	30.43	143.04
Return on operating cost	100.20%	7.84%	22.68%

Source: Auburn University. 1993. Philippine prawn industry policy study

Table 11. Comparative profitability of milkfish culture systems

	Modular System	Straight-run System
Number of runs	6	3
Production/ha (kg)	1 884	1 090
Revenues/ha/run	39 354	22 890
Total cost/ha/run	27 690	15 352
Net income/ha/year	11 664	7 538
Return on investment (%)	61	56

Source: RF Agbayani et al. 1989. An economic analysis of the modular pond system in milkfish production in the Philippines. Aquaculture, 83:249-250

Table 12. Cost and returns of oysters and mussel farms in Western Visayas, Philippines (1990)

	Oysters	Mussels
Revenues (PPs)	5 985	10 608
Costs (PPs)		
Operating costs		
Materials	2 853	4 484
Hired labour	364	1 684
Miscellaneous	146	314
Total	3 363	6 432
Non-cash costs		
Unpaid owner labour	710	360
Unpaid family labour	520	300
Depreciation	436	569
Total	1 666	1 229
Total production costs (PPs)	5 029	7 661
Operating income (PPs)	2 622	4 176
Net farm income (PPs)	956	2 947

Source: G.P.B. Samonte et al. 1993. Socio-economic study of oyster (*Crassostrea isebalei*) and mussel (*Perna viridis*) farming in Western Visayas, Philippines. SEAFDEC/AQD Tigbauan, Iloilo

Table 13. Cost and returns of seaweeds culture in Panay island, Philippines (1992)

	Bottom line	Raft monoline
Revenues (PPs)	52 758	68 823
Costs (PPs)		
Cash costs		
Seedlings	6 143	16 595
Plastic	4 050	6 300
Hired labour	2 960	3 200
Miscellaneous	1 315	2 609
Total cash costs	14 468	28 704
Non-cash costs		
Owner/family labour	2 080	7 040
Depreciation	2 923	6 713
Total non-cash costs	5 003	13 753
Total production costs (PPs)	19 471	42 457
Operating income (PPs)	38 290	40 119
Net income per crop (PPs)	33 287	26 366
Net farm two crops (PPs)	66 574	52 732

Source: G.P.B. Samonte et al. 1992. Economic analysis of bottom line and raft monoline culture of Kappaphycas alvarezii var. tambalang in Western Visayas, Philippines. Aquaculture, 110:1-11

Figure 1. The Philippines as an archipelagic country in southwest rim of the Pacific Ocean

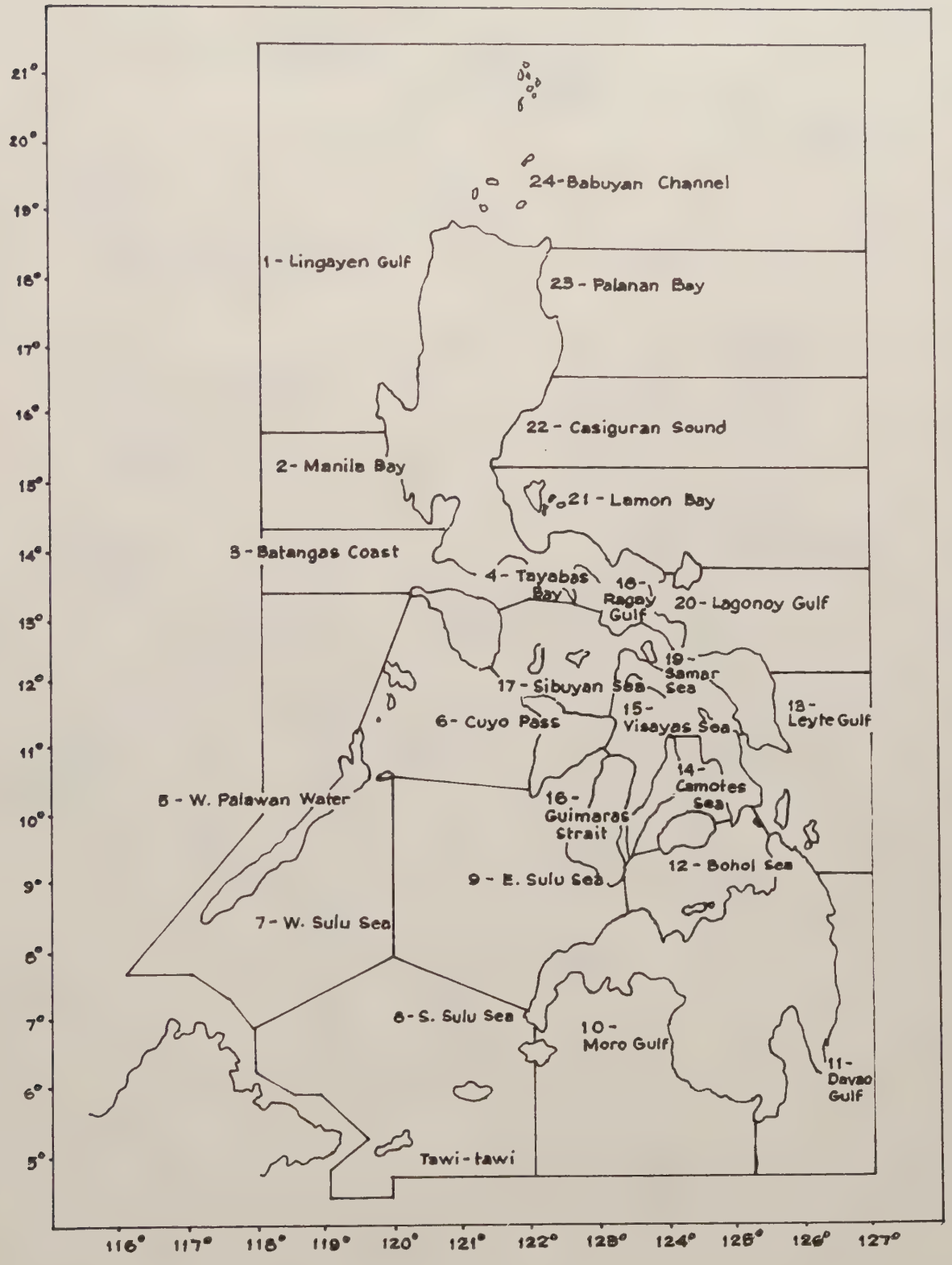


Figure 2. Map of the Philippines showing statistical fishing areas and marine fishing grounds

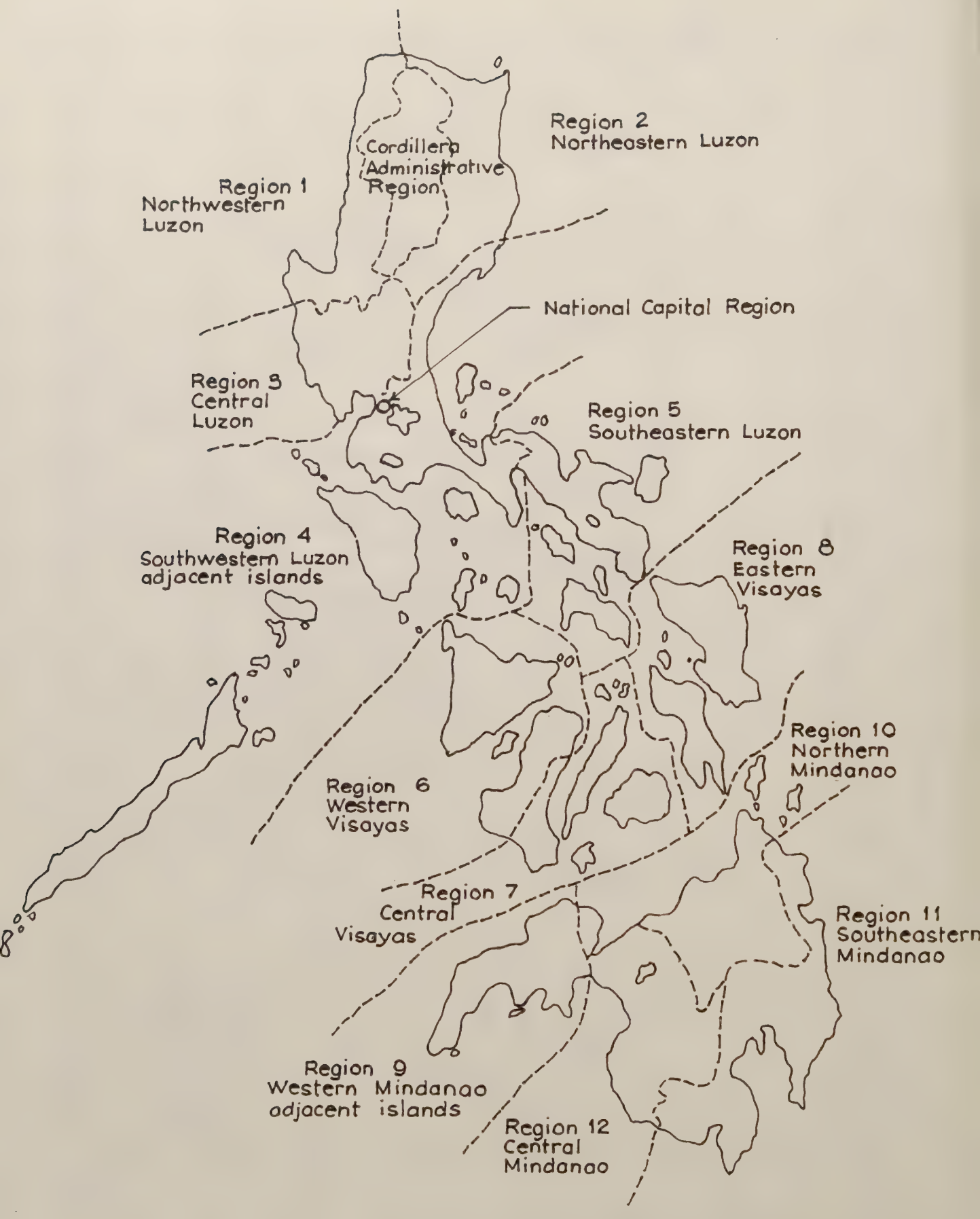


Figure 3. Map of the Philippines showing the divisions into regions

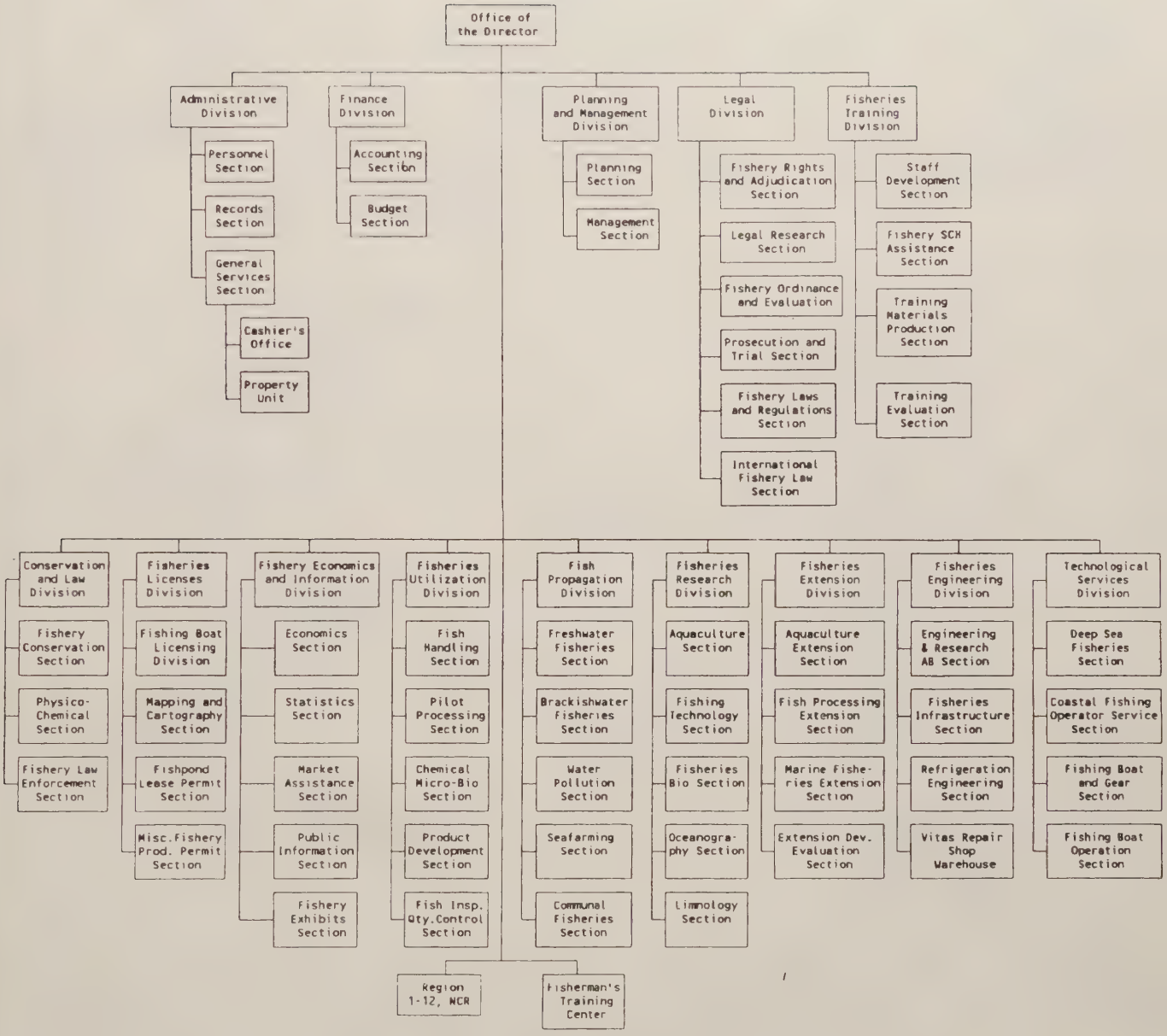


Figure 4. Organizational Structure of Bureau of Fisheries and Aquatic Resources

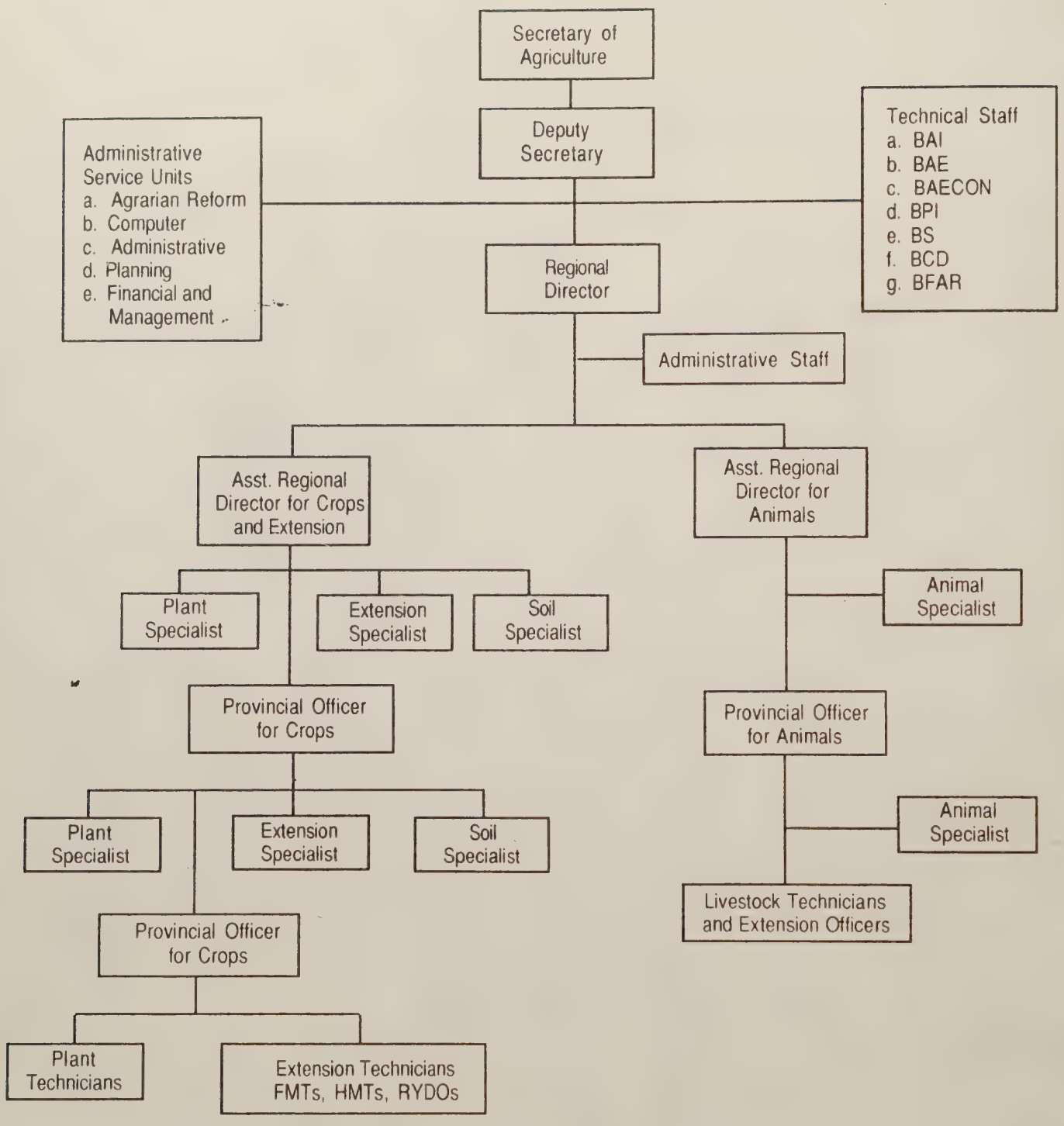
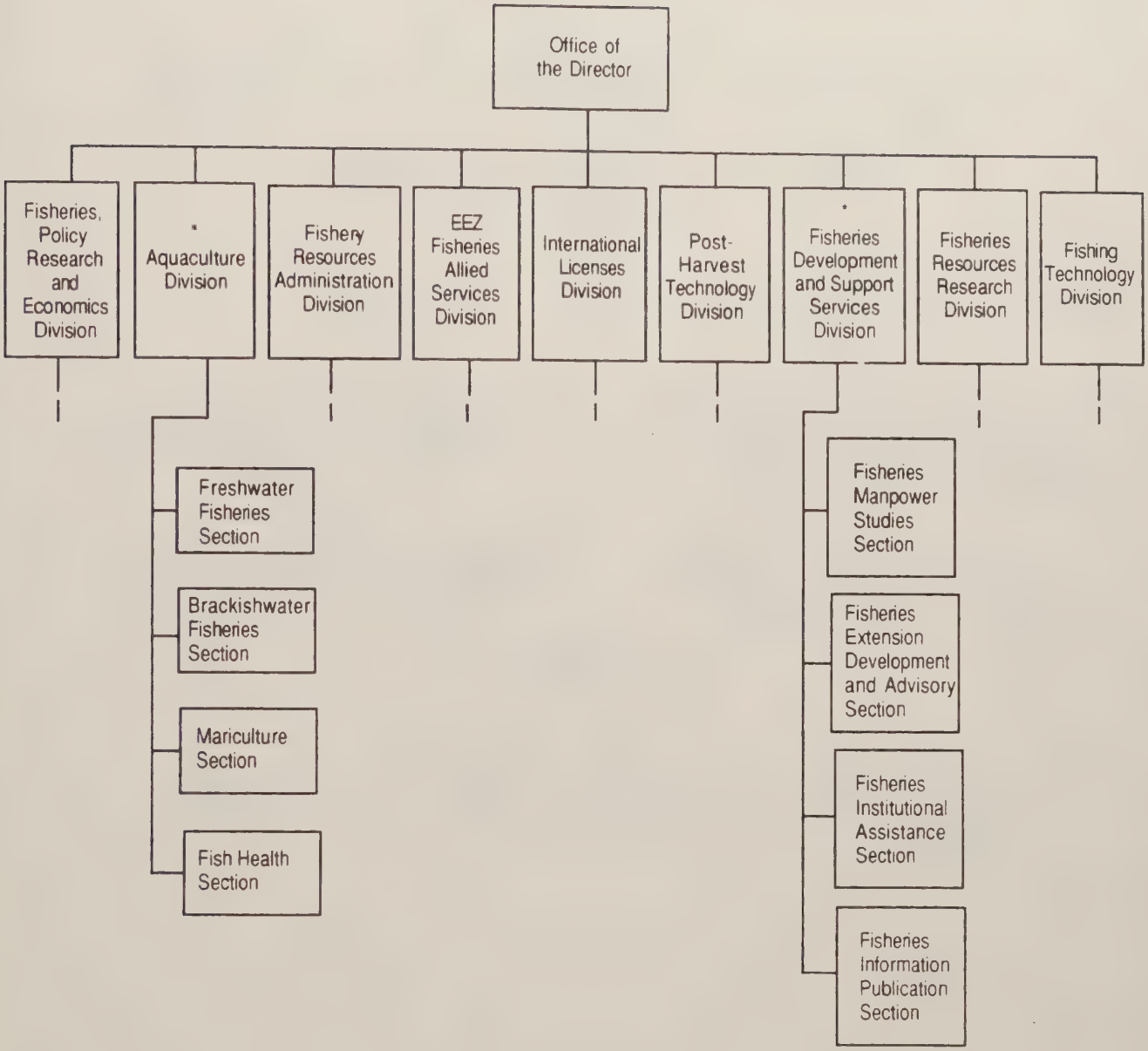


Figure 5. Organizational structure of BFAR as a staff agency of the Department of Agriculture (1984-1986)

*From Pantaleon, L. (undated)



*These are the Divisions involved in aquaculture and aquaculture extension services.

Figure 6. Organizational structure of BFAR retaining its staff status (1986-present)

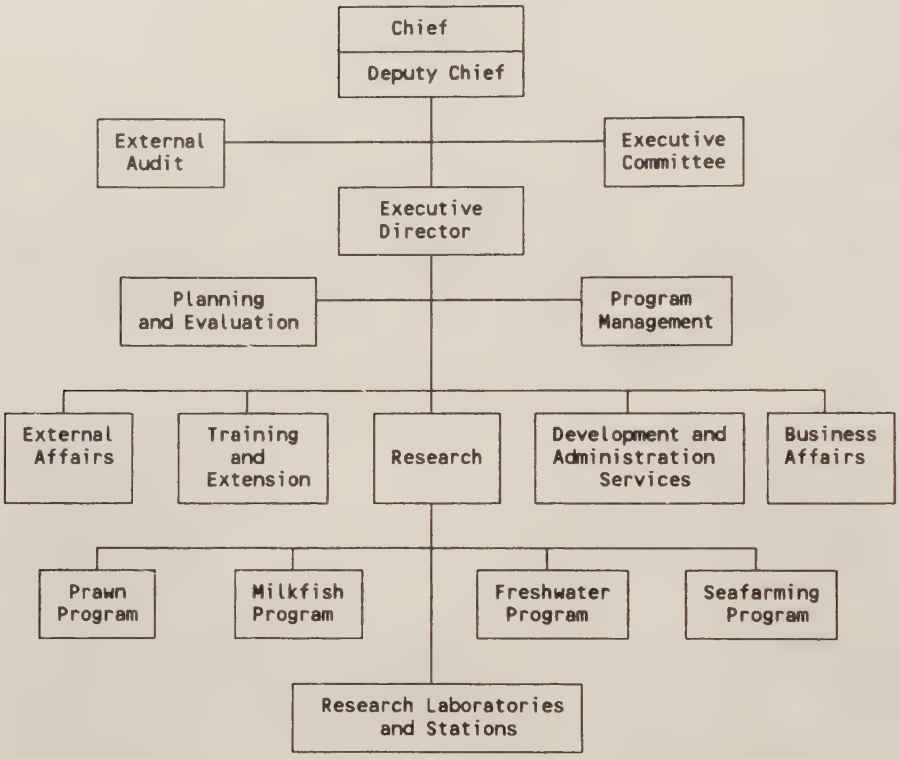


Figure 7. Organizational Chart of the SEAFDEC Aquaculture Department

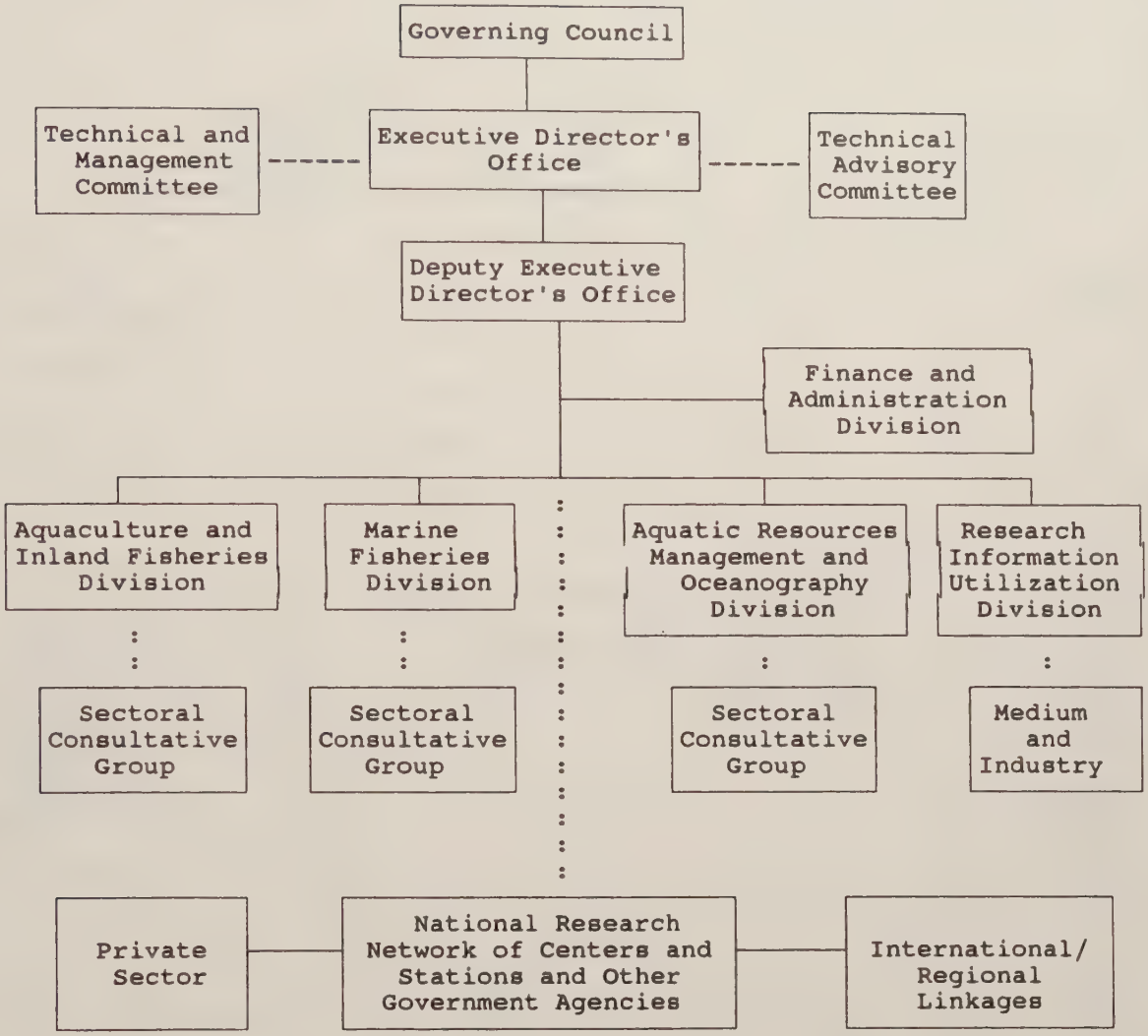


Figure 8. PCAMRD Organizational Chart

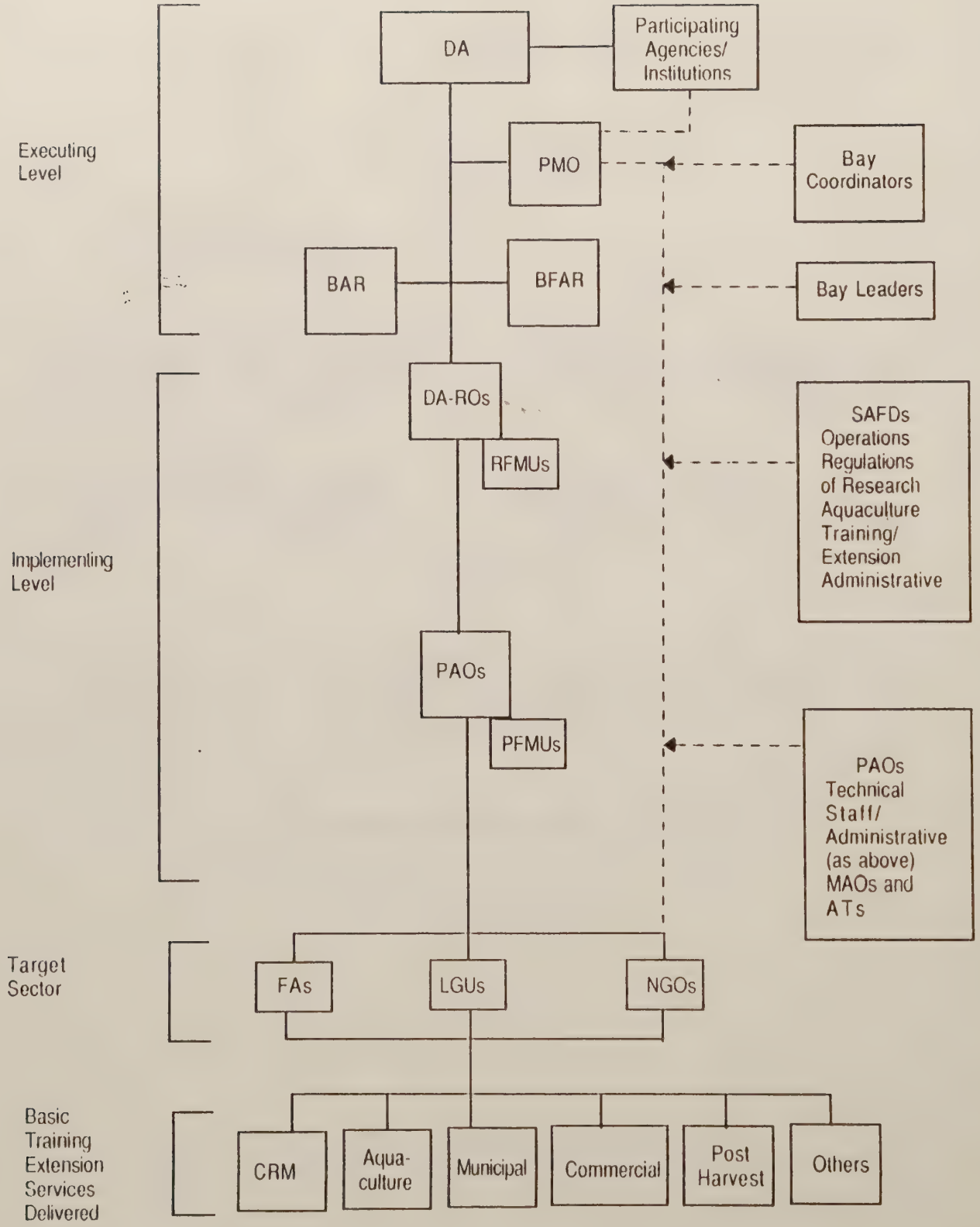


Figure 9. Fisheries Sector Program (FSP) fishery extension delivery scheme

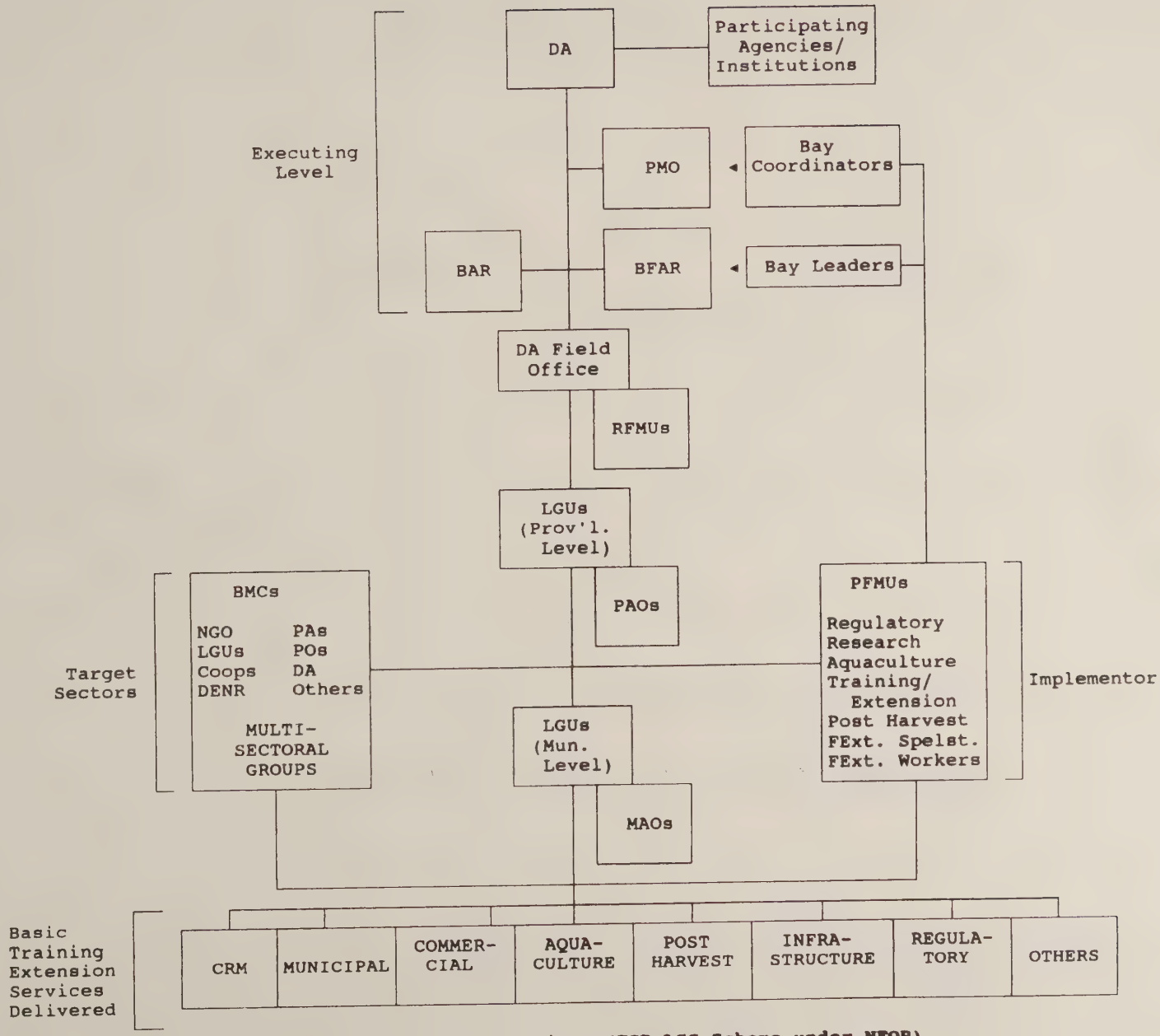


Figure 10. Fisheries extension delivery services (FSP-LGC Scheme under NFOP)

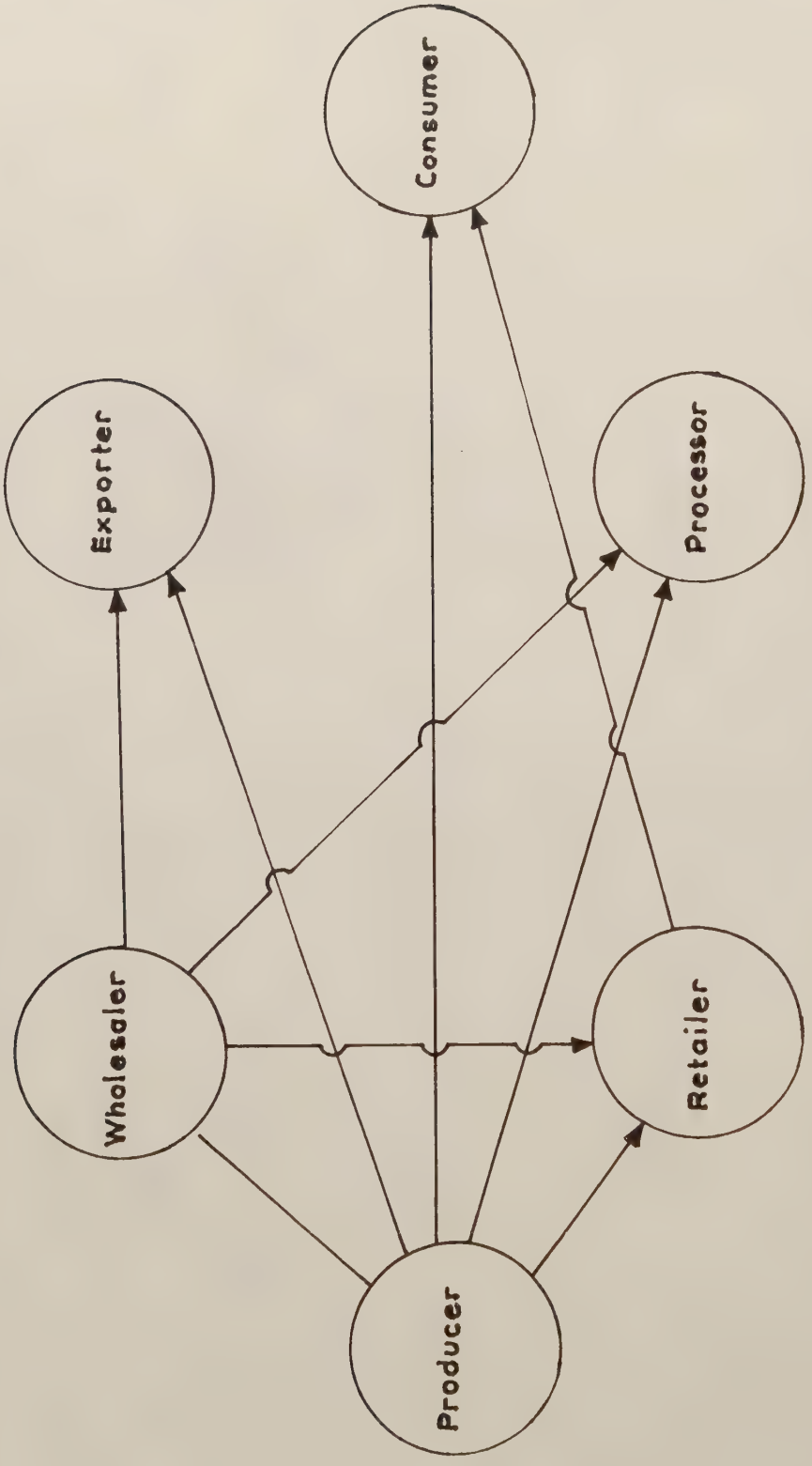


Figure 11. Market channel for fish originating from municipal fish landing centers

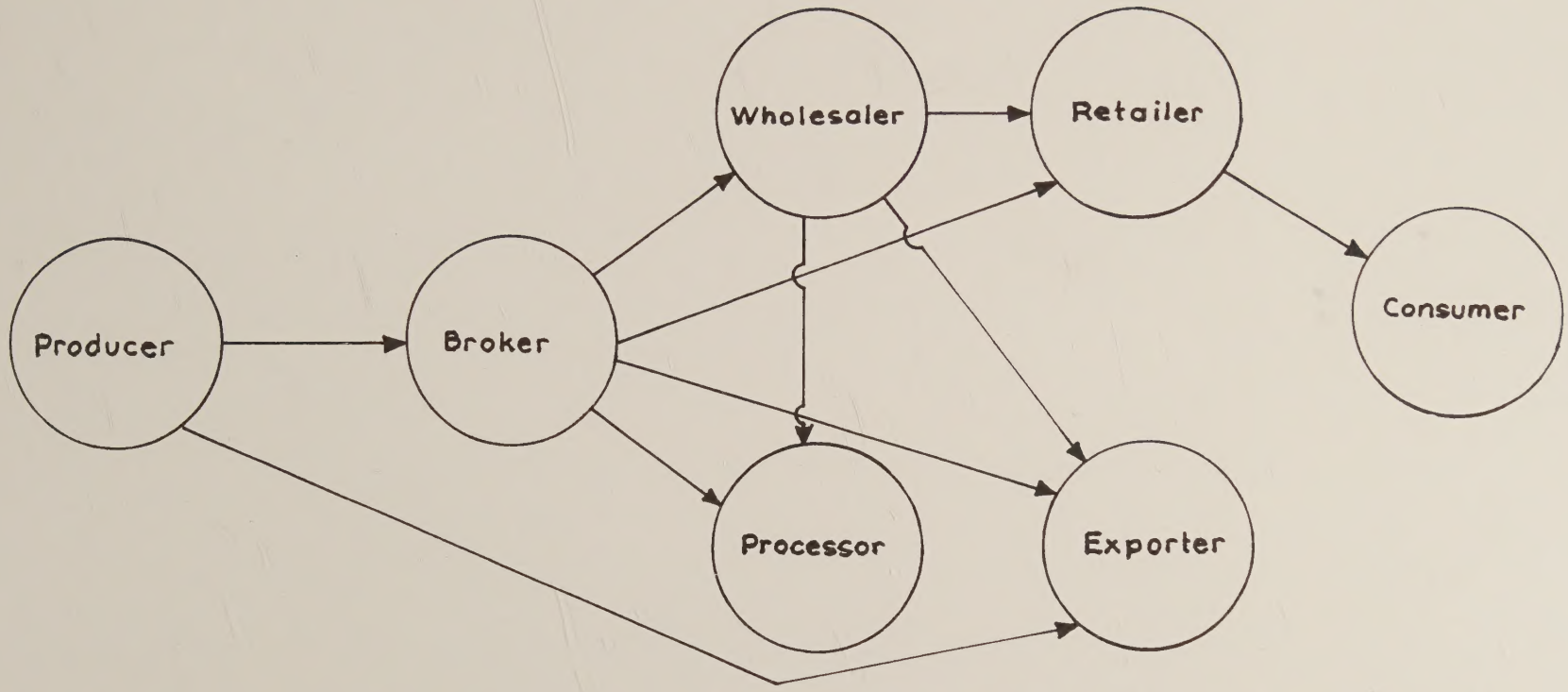


Figure 12. Market channel for fish originating from fish ports/ market centers and commercial fish landing centers

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